DISEASES OF THE KIDNEY.

Fig: 1.

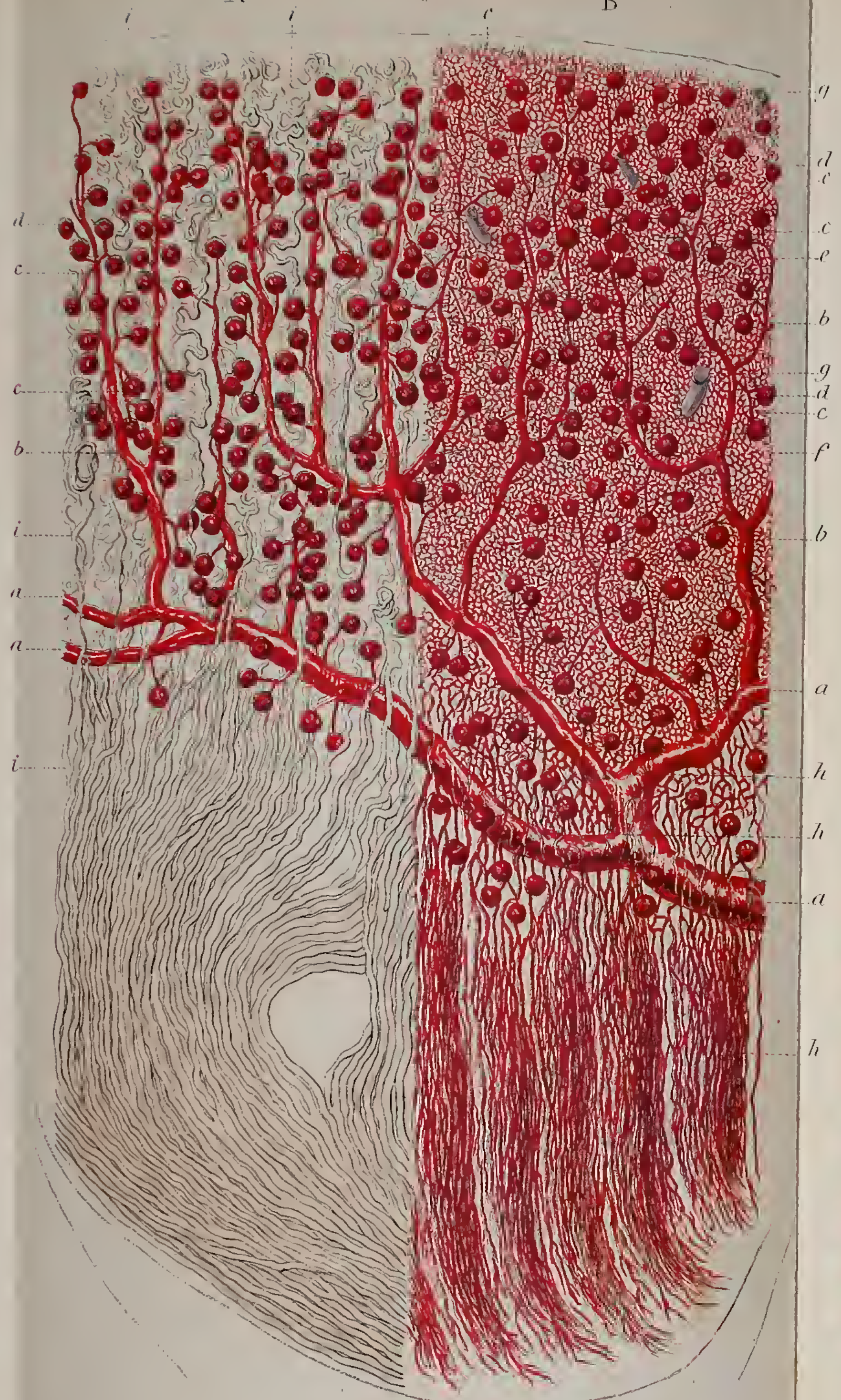
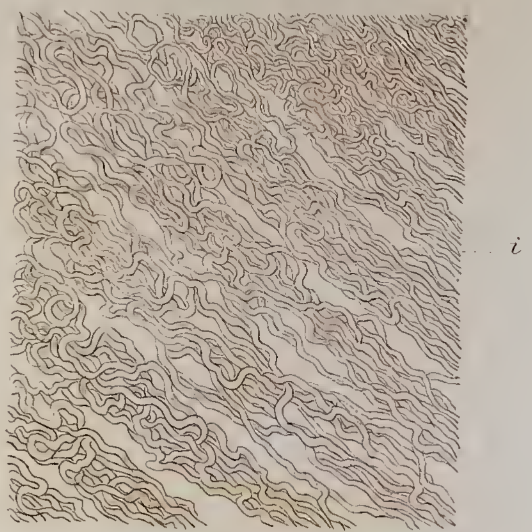


Fig: 4.



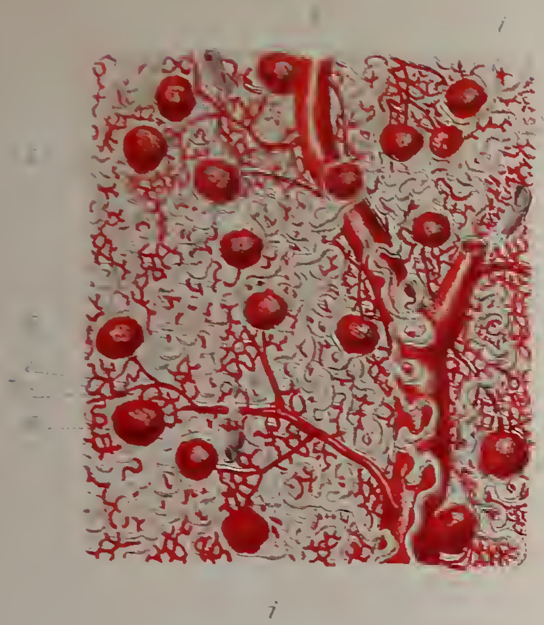


Fig: 2.

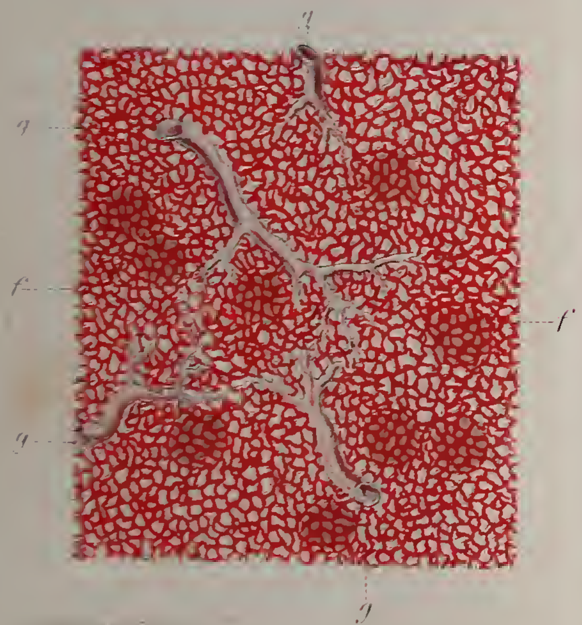
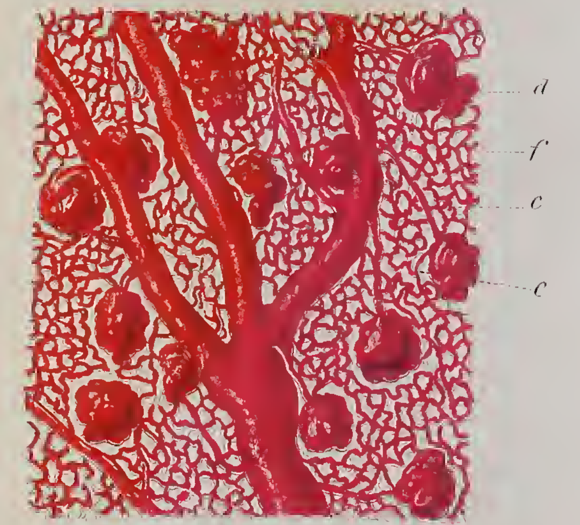


Fig: 5.



W. West, chrome imp.

LECTURES

ON THE

DISEASES OF THE KIDNEY,

GENERALLY KNOWN AS "BRIGHT'S DISEASE;"

AND

DROPSY.

BY

S. J. GOODFELLOW, M.D. LONDIN.

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LONDON:

ROBERT HARDWICKE, 192, PICCADILLY.

1861.

TO

MY CLINICAL CLERKS,

PAST AND PRESENT;

TO

MY RESIDENT MEDICAL ASSISTANT,

MR. HARPER;

TO THE

OTHER RESIDENT MEDICAL ASSISTANTS,

LATE AND PRESENT,

DR. WILLIS, & MESSRS. FOWLER, SPURGIN, & GAMBIER,

THESE LECTURES,

EMBODYING SOME OF THE EXPERIENCE DERIVED FROM THAT HOSPITAL, IN WHICH WE HAVE BEEN FELLOW-WORKERS, AND TO WHICH WE ARE ALL SO MUCH ATTACHED,

Are Dedicated,

BY THEIR FRIEND AND WELL-WISHER,

THE AUTHOR.

May, 1861.

ADVERTISEMENT.

The following Lectures appeared at somewhat irregular intervals in the *Medical Times and Gazette* during the past year. Many friends in whose opinion I plaee great confidenee, expressed a wish that they should be published in a separate volume. In obedience to this desire, it was my intention to have added much to them, and to have re-written some of them. But other pressing oceupations have prevented me from carrying this plan into exeeution. At some future period I may possibly venture to publish a more eomplete work on thc Diseases of the Kidney. Whether I do so or not will probably depend on the reeeption aceorded to thc present publication.

I am fully conseious of the imperfections and shorteomings, both in matter and in composition, of these Lecturcs, and of their incompleteness. The almost constant claims, public and privatc, on the timc of an

Hospital Physician, render it difficult to give up much of it to mere literary work. Much of the incompleteness is due to the subject. It is one of the many in medicine which are now occupying a large share of attention, and some new results of observation and experiments are coming to light almost daily. These diseases, hitherto considered so obscure and complex, seem now in a fair way of being cleared from much of this obscurity and complexity. To Dr. Bright, the eminent physician who first directed the attention of the Profession to them, we are more indebted than is generally supposed. The more his writings are studied, the more evident will this appear. His labours have been usefully followed by those of his colleagues and successors at Guy's Hospital,—Drs. Addison, Barlow, Rees, and Wilks. Dr. George Johnson also has contributed very largely to our information of these diseases; and so have Drs. Basham, Gairdner, and Frerichs. It seems a great loss to English Medical Literature that the work of Frerichs has not been translated and published in this country. By many others also our knowledge of these diseases has been extended, especially by M. Rayer, Dr. Christison, Professor Virchow, and Dr. Harris.

I cannot conclude without expressing my thanks to my old friend Professor Quekett, for the liberality with which he has permitted me to examine his rich stores of microscopical preparations, and for the loan of those from which my able artist, Mr. Tuffen West, has made some of his very beautiful and truthful drawings.

To my friend and colleague Mr. Nunn my warmest acknowledgements are due for the interest he has taken in the publication of these Lectures, without which, probably, they would never have been published at all.

5, Savile Row, W.
May, 1861.

EXPLANATION OF THE PLATES.

PLATE I.

FIG.

1. Blood corpuscles.
2. Oil globules.
3. Mucus globules.
4. Pus globules :—*a*, before the action of acetic acid ; *b*, after it, showing that the molecules which were previously scattered over the whole globules have now disappeared, and have been replaced by two or three nuclei clustered together in or near the centre of the cell.
5. Epithelium from the bladder.
6. Epithelium from the kidney : — *a*, from the convoluted tubes ; *b*, from the straight tubes, somewhat larger and more flattened than the preceding. Both kinds are drawn somewhat disproportionably large.
7. Columnar epithelium, from the orifices of some glands in the urethra, and in the vagina.
8. Blood casts of the uriniferous tubes, large and small.
9. Epithelial casts.
10. Fibrinous cast, with some imperfect epithelial cells attached to it.
11. Granular casts.
12. Granular casts, large and small, which contain numerous oil globules of different sizes.
13. Structureless casts, consisting almost entirely of oil globules, so-called oily casts.
14. Hyaline, or "waxy" casts :—*a*, large ; *b*, small.
15. Sacculated uriniferous tube.
16. Crystals of uric acid, most commonly observed in these affections of the kidney.
17. Urate of ammonia.
18. Crystals of triple phosphate.
19. Crystals of oxalate of lime.
20. Malpighian tuft, capsule, and uriniferous tube, showing the perpendicular artery, the afferent vessel, the beautiful and minute and numerous convolutions of the Malpighian capillaries, the efferent vessel, and the secondary capillaries. (From an injected preparation in the author's possession.)
21. Fibrous stroma, drawn from nature.

FIG.

21. Extraneous matters frequently found in urine: — A, penicillium glaucum; B, vibriones; C, human hair; D, fibre of coniferous wood; E, cotton fibres; F, flax fibres; G, portions of feathers; I, wheat-starch granules; K, potato-starch granules.

PLATE II.

FIG.

1. A compound figure, showing the plan of the circulation in the kidney. It represents on the left side—(A) the origin of the Malpighian tufts, and their relation to the urine-secreting tubes; and on the right side (B) the secondary capillaries, *arteriolæ rectæ,* and vasa recta, without any intervening *corpora Malpighiana.* The right (B) side is an accurate drawing from an injected preparation kindly lent by Professor Quekett. The left side (A) is after a preparation iu the author's possession, the arterial trunks being, however, made continuous with those on the opposite side. In both the preparations, most of the Malpighian bodies in the one, and of the tubes in the other, have not been inserted in the plates, in order that the plan of the circulation and the relation of the vessels to the tubes might be more clearly seen.

The following references apply to all the figures in this plate:—

a, horizontal vessel; *b,* perpendicular vessel, supporting Malpighian bodies; *c,* affereut vessels; *d,* Malpighian bodies; *e,* efferent vessels; *f,* secondary capillaries; *g,* veins; *h,* arteriolæ rectæ; *i,* tubes.

2. A representation of the same parts as in fig. 1 A, more highly magnified.
3. Secondary capillaries, showing their origin from the Malpighian bodies (*d*), and their termination in veins (*g*). (From a preparation in the author's possession.)
4. Convoluted tubes. (From a preparation in the author's possession.) On carefully looking at this figure, it will be seen how frequently the tubes are reflected upon themselves, and how intricate and taugled are the involutions which they undergo in their course towards the straight tubes.
5. Perpendicular arteries, Malpighian bodies, and secondary capillaries. The bodies are distorted, and considerably enlarged; most of the capillaries are obliterated, while others are much distended or varicosed. Many of the secondary capillaries also are obliterated, and the meshes much larger than in the normal kidney. (Taken from an injected preparation, in the author's possession, of a large white kidney that had undergone the fatty metamorphosis.)

DISEASES OF THE KIDNEY.

LECTURE I.

PREFATORY REMARKS—SYMPTOMS.

Gentlemen,—In the Lectures which I now commence it is my intention to lay before you the symptoms, causes, anatomical characters, and treatment of those diseases of the kidney which are nearly always attended, in some part of their course, with the presence of albumen in the urine. It will be my endeavour so to describe these affections that you may be able more completely to understand their true nature; and I shall illustrate my description by cases that we have now, or have lately had, in the wards of the Hospital. I shall also endeavour to give a more Clinical direction to these Lectures, by describing the symptoms in such a way as will, I hope, assist you in taking notes of these cases at the bedside, and thus render them more valuable, not only for present use, but in your future practice.

It has been found very difficult to give an appropriate name to these diseases, one which would embrace, and in some measure define, all the pathognomic symptoms as observed during life, as well as the anatomical characters as found after death. A great deal of thought

and ingenuity have been fruitlessly expended in discovering a name—and no wonder! We might as reasonably expect to find a name for all those affections of the liver which are accompanied by jaundice.

But in the present advanced state of our knowledge of these diseases do we want a name for them? It must seem clear to every one at all particularly acquainted with them, that no name can be discovered which will satisfactorily indicate all the states of the kidney accompanied by the separation of serum from the blood and its consequent presence in the urine. It is almost unnecessary for me to point out to you the objections that may be urged against every name which has hitherto been suggested, as I have so recently stated them in my systematic lectures. *Morbus Brightii* was the original name for these affections, after the able Physician who first directed the attention of the Profession "to the connection that existed between dropsy and albuminous urine during life, with certain morbid structural conditions of the kidney as found after death." If we were to regard this name as a purely arbitrary one, that comprised within it all these states of the kidney, it would be the best that could be given to them. But the objection against it, if understood in any other sense, is that it implies that all these morbid states of the kidney are different stages of one disease.

Acute and *chronic albuminuria* are names equally, if not more, objectionable. You are aware that the presence of albumen in the urine may be owing to very different conditions of the kidney, and sometimes there

is no albumen present in the urine during the whole course of the disease.

The name by which M. Rayer designates these diseases, *néphrite albumineuse,* and also that which Dr. Christison has given to them, *granular degeneration,* are equally unsatisfactory. Against that of M. Rayer it may be urged that it is doubtful whether some of these affections are due to inflammation, as his name implies, and as to the term "granular degeneration" it may be sufficient to say that in the more severe affections, and those the most rapid and fatal in their course, there is no granulation properly so called.

Dr. George Johnson's terms of *acute* and *chronic desquamative nephritis* and *acute* and *chronic non-desquamative disease,* although more precise and comprehensive than the preceding, yet are very far from indicating all the affections of the kidney, accompanied by albuminous urine, and are objectionable and unsatisfactory for this reason, as well as for others still more grave.

If then you wish to use one name for these affections I would advise you to use that of *Bright's Disease*—*Morbus Brightii,* always bearing in mind that it is an arbitrary term for different affections of the kidney having one common character in nearly every instance—namely, the presence, in some part of their course, of albumen in the urine. But as I have said before, the time has now arrived when we may give different and more precise designations for these different affections, according to the symptoms and course of the disease as observed during life, and the ana-

tomical characters as found after death. I repeat that as a general and arbitrary designation the term *Morbus Brightii* is better than any other, merely because it defines only the general nature of the disease, not in any way its precise nature. But none of you would or ought to rest satisfied with this general designation, for we have now the means of detecting with great precision the exact nature of the affection in nearly every instance. The history of the illness, and the appearances of the urine and sediments, will generally enable you to do this. When a patient presents himself to us in the admission-room, a mere glance at his pallid and puffy face and his œdematous legs is sufficient in most cases to justify our putting down the case as one of Bright's disease, and the detection of albumen in the urine will so far confirm the diagnosis. But in order to ascertain to which of the affections or morbid states of the kidney the one in question may belong, a more prolonged and a more searching examination is required. It will be necessary, with this end in view, carefully to note for a few days the total amount of urine passed in twenty-four hours, its mean specific gravity, and, approximatively, the proportion of albumen precipitated after boiling and the addition of nitric acid. When the means are at hand it would be well, from time to time, to ascertain by chemical analysis the actual amount of urea passed in twenty-four hours. This, by the discovery of a process so simple and easy of application as that of Dr. E. W. Davy, ought to be within the power of every practitioner. For a description of

this and other processes for the examination of the urine in these diseases, see Appendix. It will also be necessary to inquire into the history of the case, the precise period, as nearly as can be ascertained, at which the disease commenced, the probable or assigned cause, and, lastly, and of greater importance than all, to examine carefully the sediment which has gradually subsided to the bottom of the urinal. If there be any sediment, the form, nature, and size of the casts of the tubes, the presence or absence of blood-casts and free blood corpuscles, will almost in every instance lead you to a right diagnosis of the affection of the kidney with which you have to deal. Even the absence of all sediment in the urine, with or without the presence of albumen, will not be without its significance, if, at the same time, the urine be of low specific gravity and there be anasarca.

I will now proceed to give the general symptoms indicative of the several diseases or states of the kidney comprised in the general term, Bright's Disease. I believe that I shall include all those of any value, so that, by bearing them in mind, you may, in almost every case, detect the disease with tolerable certainty, even without an examination of the urine. But to confirm your diagnosis and to enable you to decide which affection of the kidney it may be in the particular instance that you may have before you, a careful examination of the urine, chemically and microscopically, will be necessary.

But it may be necessary for me to explain why I

give the symptoms generally of all the different affections and not proceed at once to the symptoms and signs peculiar, to some extent, to each individual affection. I do it for these reasons: first, because these affections have all some general characters in common; secondly and chiefly, because I wish you to record all the symptoms, so that you may recognise at once, in any case, any one of the affections coming under the general denomination of Bright's disease; and, thirdly, that I may assist you in taking notes of, and recording these cases by intimating the questions that should be asked, and the inquiries and examinations that should be made in order the better to study them clinically. But here permit me to say that I shall not stop in my enumeration of the symptoms to explain the manner in which they are produced, nor the exact condition of the system of which they are the signs. I shall do this by and by more conveniently.

1. *Anasarca—General Dropsy.*—Although, if we study the symptoms attentively, we shall find that this symptom has, in nearly every case, been preceded by others less definite in their character, except, perhaps, in the very acute cases,—those, for example, that we call acute inflammatory dropsy (and in some of these the observation will be found to be applicable),—although, in general, these symptoms may be preceded by others less definite, such as more or less febrile excitement, a dry and harsh state of the skin, and a quick and hard pulse; yet, in a very large proportion

of the cases, the first symptom that leads us to suspect the existence of one or other of the affections that we are now considering, is anasarca more or less general. In the more acute cases it comes on with great rapidity, and commences with puffiness of the eyelids, or of the whole face, and rapidly extends over the body. In the more chronic cases œdema shows itself in the legs, but even in these cases we may observe a dropsical and pallid condition of the eyelids, and the looser subcutaneous tissues of the face, and very often an œdematous condition of the sub-conjunctival areolar tissue, giving rise to the appearance of a tear in the eye, so frequently noticed. The anasarca, then, is what may be termed general from the commencement. Now this form of anasarca is not commonly observed in dropsies depending upon heart disease, or emphysema, or other causes, unless, indeed, these happen to be coincident with kidney disease.

2. *Pallor—Anæmic Appearance.*—From the altered character of the blood in these diseases, the surface, even in the most acute cases, rapidly becomes anæmic, and in chronic cases may show itself, and lead to the suspicion of renal disease, before general dropsy makes its appearance. Whenever, therefore, you find this pallor or this anæmic appearance, especially if the patient be above the age of from thirty-five to forty, you should never fail to examine carefully the urine for albumen, and at the same time to look for some of the other general symptoms of kidney disease. It very seldom happens, however, that you cannot detect a slight puffi-

ness of the faee and eyelids in the morning, and a slight œdema of the ankles at night; or by careful inquiry you may elieit that the patient has had some loeal dropsy, for example, hydroeele and sueh-like dropsies.

3. *Pain in the Loins.*—This is a symptom of very little value. There may be a great amount of lumbar pain, and that for a eonsiderable time, and yet no renal disease be present. The pain whieh is said to be eharaeteristie of renal disease, is a dull, aehing kind of pain, extending downwards to and involving the hips and thighs, and the external organs of generation. Pressure is said to inerease the pain. This sign, I repeat, is of very little value, for not only may it be present in the absenee of any kidney affeetion, but it is in the greater number of eases not present at all. In faet, in many eases, no unpleasant sensation is felt in the lumbar region until the anasarea beeomes eonsiderable, when it is eaused by the weight and pressure of the dropsieal effusion upon the museles and nerves.

4. *Scanty Urine and Frequent Micturition.*—In the early stages of the affeetion, as well when it is chronic as aeute, but more espeeially in the latter, there is nearly always a diminution in the quantity of the urine, and a very considerable diminution. In this case the sp. gr. may be as high as or even higher than in health, ranging from 1020 to 1025, apparently from two causes, namely, the presenee of serum, whieh is heavier than urine, and the small amount of water. Now, the urine in this stage of the disease, and under these cir-

cumstances, may contain a slightly larger proportion of urea and other constituents than healthy urine, and yet the amount of urea excreted during the twenty-four hours may fall far below the healthy average, and a quantity may be retained in the blood to work its morbific influence upon that fluid. This is entirely owing to the diminution in the quantity of the watery constituent of the urine. Instead of from thirty to fifty or even sixty ounces and upwards of water being thrown off from the system by the kidneys every twenty-four hours, as in health, the amount in these stages of the disease is seldom more than from ten to fifteen ounces, and often below this. But even where the quantity is so reduced, it is not always that the specific gravity is so high as I have just stated. In a very large number of cases of acute Bright's disease,—that, for example, following an attack of scarlatina,—you may have observed frequently in the wards that the specific gravity has been often as low as 1016 or 1017. That this specific gravity is due to the albumen may be shown by a very simple process. Coagulate the albumen by heat, and filter, so as to separate this principle when coagulated, and you will observe that the specific gravity will have fallen several units—one, two, or three, according to the amount thrown down by heat. In the more advanced stages of the disorder the kidneys again acquire the power of separating a greater quantity of water, so that we often find, as we indeed now find in the patient in No. 4 bed in Founder Ward, and the woman in No. 20 bed in Seymour Ward, that the quantity passed is fully up to,

and some days even beyond, the healthy average; but in these cases the specific gravity is almost invariably low, always making a deduction from the specific weight, as ascertained by the urinometer, for that which may be fairly ascribed to the albumen present. If you find that the water is increased, and at the same time the weight is increased, it will be a sign that the morbid process is to some extent arrested, and that the kidney is resuming its proper function. But whether the quantity of urine be small, as in the early stages of the disease, or large, as it may be in the later stages, there is nearly always a frequent desire to micturate; and in the case of the man in Founder Ward you will find that, although he passes no more than the healthy average daily, he micturates much more frequently than a person in health would be called upon to do.

5. *Frequent Micturition* is, therefore, a sign of some value when taken with the other symptoms, but by itself is of little value. You are aware that it is a symptom of many other states of the system and affections of the urinary apparatus. Now, this state of the urine, and frequent calls to pass water, lead to the consideration of another symptom of Bright's disease, not of much value however, namely—

6. *Sensation of Heat and Scalding on Passing Water.*—This is generally complained of in all stages of the disease, more especially in the chronic forms, and this symptom is frequently accompanied—especially if there be considerable anasarca—with a discharge from the urethra of mucus possessing a more or less puriform

character, so that it may be observed not only on the paticnt's linen, but in the urine also. In the latter case it generally appears in the form of slight thin shreds, either floating in the urine or subsiding to the bottom of the vessel. If cxamined under the microscope, these shreds in many eases more or less elosely resemble pns, both before and after the additions of aeetic aeid, the eells eontaining from one to three nuclei being clearly visible.

7. *Dryness of the Skin.*—It will generally be found that in all stages of these affections there is an unusual dryness of the skin, and even during somewhat active exercise there is but little if any perspiration—the power of climinating water seems impaired on the part of this great emunctory, and it is not improbable that there is a diminished power of eliminating some of the other constituents of the perspiration. There is generally a dryness and harshness of the skin, and sometimes, but not frequently (so far as my own observation extends,) an cruption of thc skin of a sealy eharaeter. The cuticular covering seems to be ill-nourished and imperfcctly formed. There is unusual desquamation of the cuticular cells, and the exuviæ are thcrcfore more than usually great. There is also more or less

8. *Heat of Skin, and a general Feverishness and occasional chilliness of the surface,* and with this,

9. *The pulse is generally above the natural standard,* and is of that character which has not inaptly been termed the "irritable pulsc." This more especially applies to the later stages of these affections; in the

more acute or sthenic forms, it is most commonly full, hard, and quick.

10. *Emaciation, and*

11. *Debility, which are progressive, from, probably, waste of serum.*

These then are the general symptoms of these affections, more or fewer being observable in every case. In the more acute or sthenic stages and forms they vary in intensity only.

But there are other symptoms of value as leading us to suspect the presence of one or other of these affections—symptoms more particularly referrible to remote organs—namely, those of digestion, circulation, respiration, and innervation.

First, with regard to the symptoms indicating disorder of the digestive organs. In enumerating these symptoms I must again remark that I shall only passingly indicate their probable cause. I shall leave the description of the manner in which they are produced until I come to speak of the exact conditions of the urine and the blood, and the effects which they induce upon the kidney itself, and upon remote organs. I repeat, that I merely enumerate these symptoms now, in order that you may enter them in your note-books for the purpose of case-taking, and for this reason I have placed them in a classified order.

Dyspeptic Symptoms—Derangement of the Digestive Functions.—These are probably due (as I shall hereafter

have occasion more fully to explain), to some small extent, no doubt, to some irritation of the stomach and intestines, from direct sympathy with the organs more immediately affected, but principally from an irritation excited by the effort on the part of the mucous membranes of these viscera to eliminate from the system vicariously that important constituent of the urine, the urea, or the salts into which it may be decomposed. It is not improbable also that these dyspeptic symptoms may be partly due to some change in the gastric juice, and the other secretions of the organs of digestion, from the retention of the urea and other constituents of the urine, which ought to have been carried out of the system by the kidneys. There are very strong grounds for believing that the retention of one or more of the constituents of any secretion or excretion in the blood, will not only impair, to some extent, the nutritive and other properties of this all-important fluid, but also lead to some alteration in the secretions of other organs, by which at first these organs, and sooner or later the whole system may be functionally disturbed, and if long continued, even organically changed. The symptoms then are precisely those which we find in irritation of the gastro-intestinal mucous membrane from any other cause, and will be in direct ratio with the acute or active character of the kidney affection. The first dyspeptic symptom is loss of appetite, sometimes amounting to actual loathing of food; at other times, the appetite is capricious and uncertain, the likes and dislikes being shown towards some particular articles of food; and

again, at another time, there may be inordinate appetite, alternating with total anorexia. The food taken always rests uneasily in the stomach, giving rise to uncomfortable epigastric and intestinal distension, flatulence, acid eructations, the explosive force of the gas thus generated being sometimes so great as to lead to the partial regurgitation of the food. There may be more or less gastralgia and pyrosis; there is very often nausea, and not infrequently vomiting; attacks of diarrhœa are frequent, and in the intervals there may be a costive state of the bowels; or, in some rare cases, as in Harris (No. 5 bed in Founder Ward), the bowels may be more or less confined during the whole course of the disease. In nearly every case of Bright's disease, in most of the forms, we find more or fewer of these dyspeptic symptoms. If in any case, then, in your practice, you find these symptoms at an age when these kidney affections are usually found, you will not be satisfied in deciding the case to be one of simple dyspepsia—that is dyspepsia arising from primary disorder of the viscera concerned—but will direct your attention to the discovery of those general symptoms of kidney disease which I have described, and especially to the state of the urine. You will not fail to perceive that these dyspeptic symptoms bear witness, not merely to gastric disorder, but also to intestinal derangement; there are not merely nausea and frequent vomiting, but there are also griping pains in the bowels, and frequent attacks of diarrhœa; there is not merely gastric, but also intestinal flatulency; and, besides these, there

is every reason to believe that the hepatic and pancreatic secretions undergo some morbid change, rendering them unfit, in some measure, for the important functions which they have to perform. The tongue is generally red and irritable at the tip and edges, and covered with a yellowish-white, creamy, fur at the root.

Next, with regard to derangement of the *circulatory functions*. The condition of the blood in these affections interferes with the heart's action, and with the circulation through the capillary blood-vessels. Palpitation is caused by slight exertion, or any mental emotion; the heart beats irritably, as if impatient of the impure blood which it contains within its cavities, and which circulates through its vessels. Its nervous and muscular structures are ill-nourished, and are temporarily, or it may be, permanently damaged. The sounds are preternaturally sharp and abrupt; the rhythm may be disturbed, the action being irregular and intermittent; and, as the disease proceeds, there may be signs of pericardial effusion, or even pericardial or endocardial inflammation.

Respiratory Organs.—Symptoms referrible to these organs are almost always observed. At first dyspnœa, which in some cases is doubtless due to the irregularity of the heart's action, and a retardation of the capillary circulation; at a later period to a sort of chronic or subacute bronchitis, as may be observed now in the patient in No. 4 bed in Founder Ward. There are other causes of dyspnœa in these affections. There is

generally more or less œdema, especially towards the base or more dependent parts of the lungs, which may act prejudicially in a variety of ways; it diminishes the resiliency of the lungs, and the action of the muscular layer of the bronchi, and thus impedes to some extent the free exit of foul air from the chest; it impedes also the entrance of air into the lungs by the quantity of fluid in the smaller bronchial ramifications and air-cells; and thus the supply of air is in some measure cut off, and the want to breathe most painfully felt. The general anasarca may increase this difficulty of breathing. The œdematous condition of the subcutaneous structures surrounding the chest, and of the connective tissue of the intercostal muscles, must to some extent interfere with the free action of these muscles, and consequently impede the thoracic movements. In acute cases at an early period, and in chronic cases at a more advanced stage, there may be signs of pneumonic engorgement, or pleuritic inflammation, or pleural effusion; and if there be a tendency to phthisis, or there be some tubercle in the lungs, the process of softening is very liable to occur, when, of course, all the evidences of this condition will be present.

Lastly, the *Brain, and other Parts of the Nervous System.*—The symptoms referrible to the nervous system are of great value, as leading to the suspicion of one or other of the diseases coming under the general denomination of Bright's disease, especially in the absence of anasarca, and when occurring coincidently with some of the general symptoms that I have already

mentioned, namely, the pallor or anæmic state of the surface, and of the face, lips, and conjunctivæ, the puffiness of the eyelids, &c. Without anticipating altogether what I shall have to say at greater length as to the cause of these symptoms, it may be well here to state that when you consider the way in which the heart is hampered, as I have cursorily described, and that impure blood is circulating through the blood-vessels and nervous substance, you might naturally expect that some disturbance of the nervous functions would be present. We consequently find, then, most of the symptoms that you all know so well, which are present in chloro-anæmia,—noise, a blowing, or sensation of ringing in the ears; occasional dimness of vision; partial amaurosis, from paralysis of more or fewer of the papillæ of the retina, giving rise to the appearance of motes or small bodies floating before the eyes —muscæ volitantes; or in other instances, flashes of light may be frequently complained of, from the irritation of the fibres of the optic nerve; throbbing of the temporal and other arteries; sense of fulness or weight at the back of the head and in the nape, with disposition to frequent cramp of the muscles of the back and sides of the neck; neuralgic pains either in the face, or in the head, or in some other parts of the body; headache, which generally appears under the form of hemicrania or the meagrims; frequent attacks of giddiness, drowsiness, disposition to coma, and in some cases even profound coma, alternating with convulsions; these last symptoms indicating most surely a fatal termination.

The disposition to giddiness is very great in some of these cases.

But besides these general symptoms, and those referrible to the digestive, the circulatory, the respiratory, and the nervous systems, there are other dispositions or affections depending upon these kidney diseases—there is an unusual predisposition to erysipelas. I have frequently observed patients attacked with erysipelas of the face, and even some other skin diseases, and these attacks recurring frequently after short intervals; and on looking for the evidence of kidney disease, the true cause of this disposition has at once been made evident.

I may here state also, that the reparative powers, in cases of wounds from surgical operations or accidents, or injuries from any cause, are considerably impaired, so that no surgeon would think of performing any surgical operation of magnitude on a person labouring under any of these diseases. And in the case of any of the secondary inflammations, or affections, to which I have already alluded, the *vis medicatrix Naturæ*—the healing and resisting power of nature—is considerably weakened.

So far as general symptoms are concerned, we are now in a position to point out more consecutively, and in "closer order," the direction in which your general clinical examination should be carried on, and the manner in which your notes of any case recorded.

First, then, anasarca. Now you will perceive that I have termed this condition a symptom; that it is a

sign of a well-understood condition there is no doubt, and you will have observed that I have given it as a very early symptom. It may be as well to state, that it has been termed a "secondary affection" by some authors; but, as I conceive, erroneously. I have already said that it is one of the earliest signs of Bright's Disease. In a very large proportion of the cases—in 99 out of every 100 of the cases—it is the first intimation of the disease; and although I do not mean to deny that other symptoms less definite in the information which they convey to the mind, may have preceded it, yet they are of trifling value as compared to this, and often escape the patient's and the practitioner's notice, until this symptom or condition has made its appearance. With reference to this symptom, in taking notes of these cases, it is necessary to describe as far as possible how it came on, what parts of the body exhibit this condition, and, as a general rule, it would be well to take the measure of the extremities, both after the patient has been in the upright position for some hours, and after he has been lying in the horizontal position in bed, so that we may be able to see and judge of the progress of the case.

Secondly. The pallor and emaciation, as "confirmation strong," that the preceding condition, the anasarca, is due to kidney disease.

Thirdly. As to whether there be any pain in the loins, and if so, what its nature is, how far it extends, and whether increased under pressure and motion, and what organs and parts it involves, and how it does so.

Fourthly. As to the quantity of water passed daily (which should always be recorded), and frequency of micturition. The specific gravity and other properties I shall enter more fully upon after I have described the condition of the urine generally.

Fifthly. As to the heat or scalding in passing urine, and whether there be any discharge from the urethra. This will enable us to separate what we may call the extraneous matters from the true kidney-constituents of this altered urine.

Sixthly. As to the state of the skin, as to dryness and heat, and the condition of the cuticle, the presence of eruptions, and so on. And

Lastly. As to the pulse, and with this the general symptoms indicating a feverish condition of the body,—chilliness, rigors, headache, thirst, &c. And in the chronic forms, your clinical history would be very far from complete if you did not inquire into and take note of those symptoms, which I have mentioned as having reference to remote organs, some of which are generally present; and in particular those symptoms and signs indicative of the secondary affections, especially those of the heart, lungs, and brain, which are of such great interest and importance, and which play such an important part in the later phenomena of the different diseases which we are now considering.

In the next Lecture I shall enter into the general consideration of the urine and the blood in these diseases.

LECTURE II.

GENERAL CONDITION OF THE URINE, AND OF THE BLOOD.

The urine presents very different characters in these several affections, and also in different stages of the same affection. I shall therefore confine myself at present to the general characters of the urine as found in all these affections, reserving the description of their peculiar characteristic and diagnostic features, as exhibited in the several affections, until I come to speak of them individually. As in the case of the symptoms, so it will be my object when speaking of the conditions of the urine and the blood, to describe them in such a way that it may guide you in your observation of cases. I have already stated that in the more acute or sthenic affections the quantity of urine voided daily is considerably diminished, and sometimes the secretion is nearly or even altogether suppressed. In this case, if not speedily relieved, the patient soon falls into a state of coma, alternating with convulsions, and a fatal result may momentarily be expected. The urine in these forms may have a specific gravity equal to, if not above, the healthy average,—16 to 25, or more; but yet, in consequence of the small quantity passed, the amount of urea excreted is much below that which is thrown off from the system in a state of health. Even

the urine that is voided of this high specific gravity may not contain the normal proportion of urea. The following analysis of Simon, shows this very clearly.

Water	948·14
Solid residue	51·88
Urea	7·63
Albumen	15·00
Globulin	1·00
Hæmatin, Extractive matter with Salts, and Hæmatoglobulin . . .	23·80

It was the case of a man, aged 20, who was suffering from what is usually called "Acute Anasarca," like that which occurs after scarlatina. The blood contained a considerable quantity of urea, but the amount of urea in the urine was only one-half, or, according to some analyses of the urine in health, only one-fifth of the normal proportion; and yet the specific gravity was within the healthy range, being 1017. An analysis of the urine of the patient now in No. 4 bed in Founder Ward, kindly made for me by our Lecturer on Chemistry, Mr. Heisch, shows this very clearly. This man was passing urine of specific gravity varying from 1018 to 1020. The quantity passed in twenty-four hours, sent to Mr. Heisch, had a specific gravity of 1019. In 1000 grains of the urine there were 8 grains of urea. This proportion is very much below the average of health. But he passed only 19 ounces in the twenty-four hours, and consequently the whole of the urea excreted by the kidneys in twenty-four hours was only 105 grains; whereas Mr. Heisch has

found from analyses of the whole of the urine passed in twenty-four hours by a healthy man, the quantity of urea varied from 230 to 280 grains. Lehmann found from his analyses that it nearly doubled this; and other Chemists, that it is even as high as 600 grains and upwards. From a table lately published by Dr. Parkes, it appears that the daily average is 512·4 grains.

With reference to the specific gravity, it is necessary for me to say that it depends in some measure upon the diet, the amount of exercise, the constitution, and the sex of the individual. In females it is commonly lower than in males, lower in childhood and old age than during the middle periods of life, lower on a mixed diet than on a purely animal diet, and what *a priori* might not have been expected, lower than on a purely vegetable diet as discovered by Lehmann. With regard to this last, however, it is probably owing to the diminution in the quantity of water in the urine under a purely vegetable diet, that this unexpected result was obtained. The result of Lehmann's very interesting and important experiments may be more clearly seen in the subjoined table :—

EFFECTS OF DIET UPON URINE—LEHMANN.

Urine daily.	Mean Sp. Gr.	Solid Matter daily.	Solid Matter per 1000 of Urine.	Urea daily.	Percentage of Urea in Solid Matter.	Urea in 1000 of Urine.	Uric Acid daily.	Uric Acid in 1000 of Urine.	Percentage of Uric Acid in Solid Matter.	Extractive Matter daily.	Salts daily.	Lactic Acid daily.	
												Free.	Combined.
ORDINARY MIXED DIET.—OCTOBER.													
16,293 grs., or about 34 oz.	1022	Grs. 1044·452	65·794	Grs. 500	46·23	29·33	Grs. 18·3	1·089	1·71	161·865	34·931	Grs. 22,561	Grs. 17,931
EXCLUSIVELY ANIMAL DIET.—JUNE.													
18,557 grs., or about 38·5 oz.	1027·1	1350·374	75·48	820·6	61·297	47·4	22·8	1·29	1·42	89·783	23·055	33,441	(?)
VEGETABLE DIET.—AUGUST.													
13,981 grs., or about 29 oz.	1027·5	914·037	66·41	366·9	39·086	26 81	15·756	1·14	1·737	254·612	32·188	18,548	21,157
NON-NITROGENOUS DIET.—JUNE.													
16,126 grs., or about 33·5 oz.	..	643·205	..	236·8	..	..	11·265	..	..	182·85	..	Lactic acid and Lactates. 89,815 grs.	

It will thus be seen, that although the specific gravity of the urine actually passed after a vegetable diet was about the same as that from a purely animal diet, yet the solid constituents were much less, especially the urea and uric acid. During exercise, also, the specific gravity and the amount of urea, uric acid, and other solid constituents are increased, in great part doubtless from the activity of the respiratory, but more especially of the cutaneous function. It must to some extent, also, be ascribed to the great amount of urea from the waste of the muscular tissue. Seeing these differences, then, in the urine under these different circumstances, as to age, constitution, sex, diet, and exercise, it must seem clear to you that in drawing your conclusions from the specific gravity of different samples of urine, you ought to take these circumstances into calculation, and make some allowances for them. Some states of health, also, will make a considerable difference in respect of the specific gravity.

In order to make some definite and useful conclusion from the specific gravity as to the amount of solid constituents in the urine, there are two ways of roughly, I may say clinically, arriving at an approximative result. One is the formula of Dr. Christison, the other owes its origin to Dr. Bird. I repeat that it is only an approximative result that you can arrive at by these formulæ; for you will see by the tables of Lehmann, which I have just quoted, that the quantity of solid constituents is not always in proportion to the

specific gravity. The formula of Christison is this:—If D = the density or sp. gr. of urine, and Δ = difference between 1000 and its density, the quantity of solids in 1000 grains will = Δ × 2·33 = 23·30. Thus, *e.g.* supposing the sp. gr. be 1020, then 20 × 2·33 = 46·60, which is the amount of solids in 1000 grains of urine. The same formula has been used by Dr. Henry and by Becquerel; but Dr. Henry assumed that the quantity of solids in 1000 grains was Δ × 2·58, which is too high, and Becquerel assumed it to be Δ × 1·65, which is too low. In addition to these, I may mention Trapp's formula, the error of which, according to Vogel, cannot exceed $\frac{1}{10}$ in health, and $\frac{1}{5}$ in morbid urine. If Δ represents the excess of the sp. gr. of urine above that of water (= 1000), the amount of the solid constituents of 1000 parts of that fluid will be represented by 2 Δ. As this is the simplest means of arriving approximatively at the amount of solids for those who are engaged in studying kidney diseases at the bedside, and at the same time the most accurate, I will not stop here to describe that of Dr. G. Bird. The following table, however, calculated by Dr. G. Bird, according to Christison's formula, will show at a glance the number of grains of solids, and the weight of a fluid ounce of urine, of every density, from 1010 to 1040.

Specific Gravity.	Weight of 1 fluid oz.	Solids in 1 fluid oz.	Specific Gravity.	Weight of 1 fluid oz.	Solids in 1 fluid oz.
	Grs.	Grs.		Grs.	Grs.
1010	441·8	10·283	1025	448·4	26·119
1011	442·3	11·337	1026	448·8	27·188
1012	442·7	12·377	1027	449·3	28·265
1013	443·1	13·421	1028	449·7	29·338
1014	443·6	14·470	1029	450·1	30·413
1015	444·0	15·517	1030	450·6	31·496
1016	444·5	16·570	1031	451·0	32·575
1017	444·9	17·622	1032	451·5	33·663
1018	445·2	18·671	1033	451·9	35·746
1019	445·8	19·735	1034	452·3	36·831
1020	446·2	20·792	1035	452·8	37·925
1021	446·6	21·852	1036	453·2	38·014
1022	447·1	22·918	1037	453·6	39·104
1023	447·5	23·981	1038	454·1	40·206
1024	448·0	24·051	1039	454·5	41·300

I must repeat, that by formulæ of this kind we ean only gain an approximation to the truth; for, as you will see by some of the diagrams as I proeeed, the various elements of the urine may possess different densities, and these, again, may not always exist in the same proportion. Yet they are of great value in the investigation of disease at the bedside, and I would recommend you to eopy this table in your note-books, as well as Dr. Christison's formula, which will enable you in any case to form an independent judgment. Dr. Day has shown by his researehes, that of the three formulæ that I have mentioned, Dr. Christison's is the most exact, and affords results generally sufficiently aeeuratc for the guidance of the Praetitioner.

In the ehronie or asthenic forms of these discases, espeeially in an advanced stage, instead of the urine

being scanty in quantity, and having a tolerably high specific gravity, as in the acute and sthenic forms, the urine passed in twenty-four hours may amount to from thirty-five to fifty ounces or more; being equal to, and in some cases greater than, the average in health. In this case, however, the specific gravity is nearly always below the healthy average, the urine is almost always pale, and in the most advanced cases, almost colourless. Occasionally it may be red, or reddish brown, or pale smoke-brown—"smoky," as we call it in the wards. It also may present a peculiar lemon, or rather orange tint, which is said to disappear on the coagulation of the albumen. A slight muddiness or opalescence may also at times be observed, which Dr. Christison is inclined to think is due to mucus of the bladder. It is generally slightly acid when recently voided, sometimes neutral, or even alkaline. Very often there is froth at the top, which continues for some time after the urine has been voided; it carries, as the spirit-dealers say, a "good bead." Sometimes it presents a milky appearance; in which cases we shall always discover, on closer examination, evidence of fatty matters.

Such, then, shortly stated, are the physical properties as observed by the naked eye. We come now to consider the *Chemical Condition of the Urine*, which is of much greater importance to us; and with reference to this, it is much to be regretted that we have not had more satisfactory investigations and analyses of the urine and the blood in these diseases. With

reference to the blood, there is great difficulty. It is not in our power to get enough blood—that is to say, we cannot always, if ever, feel justified in drawing such an amount of blood from patients labouring under these diseases as will enable even an expert chemist to ascertain the exact quantity of urea present. But with regard to the urine, there is really no excuse. The analyses that have already been made are not so satisfactory as we could desire, but I think we may depend upon the results so far as they have been carried. I may state here, that, to carry on examinations of the urine in these diseases, it is not sufficient to take a certain quantity of any one sample of urine that may have been recently voided; but, in every case, the whole of the urine passed in twenty-four hours should be collected and the exact quantity noted. Out of this a certain quantity may be taken for analysis, and the proportion of the constituents, natural and adventitious, as found by analysis, will show exactly the amount of these several constituents actually voided in twenty-four hours. In this way we can easily calculate what is passed in a week, or in any longer period; for while the specific gravity and obvious physical properties remain about the same, the probability will be that the proportion of the different constituents will remain nearly, if not precisely, the same, and another analysis need not be necessary until the specific gravity and colour of the urine, and amount of albumen, ascertained by heat and nitric acid, undergo some change. As an additional reason for this,

if indeed any were wanted, I may state that it is well known that the urine undergoes very important alterations, both in its sensible and chemical qualities, when the stomach is empty, soon after taking food, and at the end of the digestive process. Dr. Bence Jones long ago pointed out that soon after taking food the urine becomes pretty nearly alkaline, and that it gradually becomes more and more acid until the time of taking the next meal. But the urine undergoes other and more important alterations in these conditions. The following extract from Bernard shows this very convincingly :—"About ten years ago I obtained a number of rabbits, and as it was for the purpose of discovering the modifications which the urine exhibited from the passage of certain substances injected into the blood, I felt it necessary to have them in every respect as nearly alike as possible. In fact, those which I obtained were of the same size, the same age, and the same colour. I commenced my experiments by examining their urine. I found that in some it was clear, acid, and contained a considerable quantity of urea; while in others it was troubled, alkaline, and contained a great quantity of the carbonates; and lastly, in others, the urine was neutral, in some opaline, and in some clear. It was evident, then, that some physiological conditions, other than those upon which their general resemblance depended, such as size, age, and colour, were in operation, and these conditions were found to depend upon the different states in which they were placed with regard to alimentation.

In the first, the animals had been allowed to fast for some time; in the second, gastric digestion was going on actively, and in the others, digestion was nearly, if not completely over."

Whenever an opportunity occurs, the blood should always be examined for urea; but, as I have just stated, very imperfect evidence of the presence of urea can be obtained from small quantities of blood. These analyses have, however, been made by some chemists, as you observe in the tables before you. These tables, as well as the results of other analyses, which I shall more particularly allude to by-and-by, render it a matter of no doubt, that the small amount of urea excreted by the kidneys is more or less an index of its presence in varying quantities in the blood, and the general conditions of these two fluids are so far satisfactorily established as to afford sufficient ground for the explanation of the proximate cause of the symptoms and the secondary affections, which I shall give in my next Lecture.

Chemical Condition of the Urine.—Before we enter upon the consideration of the *adventitious* constituents of the urine in these diseases, it is desirable to direct our attention to the proportions in which the *normal* constituents are found in the healthy state. Unfortunately, here, as in the case of diseased urine, the analyses have not in general been made in such a way as to show the *average* proportion of the several ingredients in twenty-four hours. As a praiseworthy

exception to this, I place before you three analyses made by C. G. Lehmann. They were made with the collected urine of the past twenty-four hours of a young well-fed man of the sanguine-bilious temperament, who took only a very moderate quantity of drink, and in whom the urine perhaps was somewhat more concentrated than usual. But even if the analyses were made so as to obtain the average of urea and other constituents in twenty-four hours, we ought to make due allowance for the natural and very great differences in the quantity of these voided by persons in health, of very different constitution, and different habits, as to food, clothing, and exercise. Our analysis, therefore, in disease can only be approximatively correct; and if we find the *mean* quantity of urea and other constituents thrown off from the system in twenty-four hours is only a half or two-thirds of that of the same constituents as found in health, we may conclude that the kidneys in these diseases are rendered incapable, to a certain extent, of separating the urea and other salts from the blood, and that, therefore (as found to be the case on analysis of the blood), some urea and other salts (uric acid, *e. g.*) still remain in the blood. This remark, with regard to the analyses of the urine in these diseases, is equally applicable to those of the urine in all diseases; for, if you will refer to Simon's and Lehmann's works, as published by the Sydenham and Cavendish Societies, on the analyses of the urine in different diseases, you will find every proportion of the constituents in one and the same

disease, and it will be impossible to come to any but an approximative conclusion.

LEHMANN'S ANALYSIS.

	1.		2.		3.	
Water	937·682		934·002		932·019	
Solid residue	62·318		65·998		67·981	
Urea	31·450		32·914		32·909	
Uric Acid	1·021		1·073		1·098	
Lactic Acid	1·496		1·551		1·513	
Water extract..	0·642		0·591		0·632	
Spirit and Alcoholic extract	10·059		9·871		10·872	
Lactates	1·897		1·066		1·732	
Chlorides of Sodium and Ammonia	3·646	15·837	3·602	15·744	3·712	16·130
Alkaline Sulphates	7·314		7·289		7·321	
Phosphate of Soda	3·765		3·666		3·989	
Do. Lime and Magnesia	1·132		1·187		1·108	
Mucus..	0·112		0·101		0·110	

BECQUEREL'S ANALYSIS,

which agrees pretty closely with those of Simon, Marchand, and Day.

	Mean Composition of Urine in a Healthy Man.	Mean Composition of Urine in a Healthy Woman.	General Mean.
Specific gravity	1018·9	1015·12	1017·01
Water	968·815	975·052	971·935
Solid constituents	31·185	24·948	28·066
Urea	13·838	10·366	12·102
Uric Acid	0·391	0·406	0·398
Fixed Salts	7·695	6·143	6·919
Organic Matters	9·261	8·033	8·647

On looking at these tables we cannot but be struck with the very great difference in the proportion of the normal constituents of urine in healthy persons. In those of Lehmann they are doubtless above the

average, as in those of Becquerel they are much below it. But even here the difference is more apparent than real. You will perceive that the great difference is in the quantity of water, as is clearly shown in the following tables. The differences are exhibited in a much less striking manner, although to a certain extent they still exist.

	Berzelius.	Lehmann.		
Urea	45·10	49·68	48·39	49·10
Uric Acid	1·50	1·61	1·57	1·63
Extractive Matter, Ammonia-salts, and Chloride of Sodium	36·30	28·95	25·80	29·54
Alkaline Sulphates	10·30	11·58	10·71	10·92
Alkaline Phosphates..	6·88	5·96	5·38	5·65
Phosphates of Lime and Magnesia ..	1·50	1·97	1·73	1·65

	Simon.					Marchand.		Day.
Urea..	33·80	33·10	30·07	37·80	36·20	48·91	49·58	42·56
Uric Acid	1·40	1·60				15·9	1·63	1·56
Extractive Matter, Ammonia-salts, and Chloride of Sodium.. ..	42·60	46·00	50·90	47·90	47·37	32·49	31·74	
Alkaline Sulphates ..	8·14	8·80	10·01	11·00	12·00	10·18	10·15	
Alkaline Phosphates ..	6·50	5·70	6·75	6·25	6·80	4·57	4·90	
Phosphates of Lime and Magnesia	15·9	1·50	1·75	1·46	1·62	1·81	1·63	

Such, then, is the proportion in which these constituents of the urine are found in health. How are they affected in diseases which we are now considering? The following table will show this very clearly.

ANALYSIS OF URINE IN DISEASE (BECQUEREL).

Specific gravity	1016·3	1010·0	1007·5	1008·4	1005·4	1012·6	1010·0
Amount of Urine in 24 hours, in ounces ..	28·0	35·2	62·0	78·0	106·0	25·3	
Water	965·0	981·5	987·5	986·3	989·1	975·5	981·5
Solid constituents ..	35·0	18·5	12·5	13·7	10·9	24·5	18·5
Urea	11·6	6·3	6·3	1·8	3·8	7·5	5·9
Uric Acid	0·3	0·6	0·3	0·2	0·2	0·4	0·4
Albumen	11·9	2·5	0·1	3·4	2·6	5·9	
Fixed Salts..	6·6	4·1	2·5	2·9	1·7	4·9	3·7
Extractive Matter ..	4·6	4·8	3·2	5·5	2·5	5·7	4·7

Thus we find, by comparing the two sets of Tables—those of health, with those of disease,—that the proportion of urea ranges in health from 11 or 12 to between 32 to 33 parts in 1000 parts of urine, while in these affections of the kidney, it is only found in one of the cases noted in the tables as high as 11, and this was when the quantity of water was much below the average proportion, and at the outset of the disease. In nearly every other instance it was found varying in proportion from 7½ to below 2 parts in 1000.* The

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* In the case of a man (John Kemp) who was admitted into Founder Ward on the 18th of December, 1860, suffering from acute anasarca, seemingly from frequent and prolonged exposures to cold and wet, the mean quantity of urea passed daily during 41 days was found to be 221·88 grains, and 5·16 grains in 1000; while in another case (Samuel Harris), in Founder Ward, who was labouring under a more chronic form of Bright's Disease, or rather from a sub-acute, grafted upon a chronic form, the daily average was 159·61 grains, and 7·486 grains in 1000.—In the former case the daily average quantity of urine was in round numbers 4½ pints, and the sp. gr. 1010; while in the latter the daily average amount of urine was in round numbers 43 ounces, and the sp. gr. 1013.—The diet in the two cases was nearly the same. The two cases are of interest in many respects. The following were the leading particulars in the case of John Kemp, to which I have added a table giving the specific gravity of the urine, the quantity daily or almost daily passed, the amount of urea contained in the diurnal discharge, and the quantity in 1000 parts. To my very efficient Resident Medical Assistant, Mr. Harper, I am indebted for these very careful observations.

John Kemp, æt. 23, admitted into the hospital December 18th, 1860.

Personal Description.—Height about 6 feet; good muscular development; small amount of subcutaneous fat; hair dark brown; eyes hazel; conjunctivæ bluish white; complexion florid.

Family History.—Father died at the age of 47, but of what disease is unknown; mother died at the age of 50, of apoplexy—has a brother

uric acid seems to undergo a less notable difference. In health it runs from 0·391 to 1·098; in these dis-

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and a sister alive and in good health; but the former "had a touch of the dropsy" some years ago, of the cause of which he is ignorant.

Previous History.—Has been for some time a porter to a cheese-monger, in which occupation he is much exposed to all kinds of weather. Has always enjoyed good health; does not remember having had any serious illness, certainly not scarlatina nor small-pox. Has been out of work for some time past, and has therefore lived rather poorly; is usually in the habit of drinking about a quart of beer daily, with sometimes some gin. For the last month has been much exposed to wet and cold—his clothes being frequently saturated with wet, and while in this state he has continued to wear them.

History of Illness.—About a fortnight ago he was seized with slight febrile symptoms, and in a few hours afterwards he noticed puffiness of the face, which was followed in the course of four or five days by swelling of the legs and increase of thirst. He was not conscious of any difficulty in passing urine, of any increased frequency of micturition, or of any pain in the back.

On Saturday last (four days ago) the abdomen became swollen and tense, and the legs more œdematous, and he now suffered from pain around the loins. But there was no retraction of the testes, nor did the pain extend downwards towards the groins and thighs.

On his admission there was very considerable anasarca; the integuments of the face were very œdematous, and the scrotum and penis were much swollen. The abdomen measured in circumference on a level with the umbilicus 36½ inches—Cardiac dulness was somewhat increased; and sounds distant, and unaccompanied by murmurs; complains of pain in the loins which is increased on pressure; urine scanty, smoky, acid, of sp. gr. 1024, and highly albuminous—Has slight cough, respiration quick—surface of body cool, skin dry.

C. C. lumbis ad ℥vj., et postea Cataplasma Lini.

Pulv. Jalapæ co. ʒss. cras mane.

H. Ammon. Acetatis c. Vin. Antim. Potassio-tart. mx. 4tis horis.

Simple Diet (12 oz. of bread, 1 pint of milk, 1 pint of gruel).

December 19.—The pain in the loins no longer felt; the swelling remains the same; bowels have acted four times from the powder; motions copious and fluid; urine still scanty, and there is a consider-

eases it varies from 0·6 down to 0·2. Another very important, but rather indefinite ingredient in the urine

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able deposit of lithates. Under the microscope numerous blood-corpuscles were observed, but no tube-casts of any kind.

Rep. Haust. et Pulv.

Baln. Calid.

December 20.—The swelling of the legs somewhat diminished, but that of scrotum, penis, and abdomen the same ; tongue covered with a whity-brown fur ; thirst abated ; two loose motions after the powder ; urine still scanty, about a pint only in the twenty-four hours, still highly albuminous ; pulse 70, soft ; perspired slightly during the night ; slept well ; no headache ; free from lumbar pain.

Rep. Haust. et Pulv.

December 22.— The swelling remains much the same as on the 20th ; tongue large and flabby ; thirst now almost gone ; appetite improving ; five motions after the powder ; pulse 88, of a somewhat jerking character ; urine still scanty, very high-coloured, and smoky ; numerous blood-corpuscles observed in the deposit, but still no casts.

Baln. Calid. hâc nocte.

Haust. Ammon. Acetatis 4tis horis.

He continued much the same, secreting about a pint of the same sort of urine up to the 24th, when the following draught was ordered to be taken every morning, the Haustus Ammon. Acetatis being continued every four hours as before.

Magnes. Sulph. ʒij., Acidi Sulph. Dil. mx., Ferri Sulph. gr. ij., Sp. Myristicæ ʒss., Aq. ad ℥iss.

December 25.—From seven o'clock p.m. yesterday to the same hour to-day, passed five pints of urine of a sp. gr. 1011, still of a dark smoky colour, becoming opalescent by heat and NO_5.

On the 26th he voided four pints of the same kind of water : the quantity of albuminous precipitate thrown down by heat and NO_5 was about $\frac{1}{4}$.—The general anasarca much diminished.

Capt. Tinct. Ferri Sesquichlor. mx. ex aquâ ter die.

Cont. Haust. Ammon. Acetatis 4tis horis.

From this time the anasarca rapidly diminished, and the proportion of albumen gradually decreased—the daily amount of urine will be seen in the accompanying table.

undergoes a great diminution in this disease—those substances called by chemists the "extractive matters."

On the 8th of January he complained of a slight pain in the left side on taking a deep inspiration, but no pain in the loins. All evidence of anasarca and ascites had disappeared on the 7th instant.

Omitt. Haust. Ammon. Acetatis.

C. C. parti dolenti ad ℥iv. vel ℥vi.

Pt. in Haustu Tinct. Ferri Sesquichloridi.

On the 8th of February he was discharged as an out-patient, but there was still a trace of albumen in the urine.

AMOUNT OF UREA CONTAINED IN JOHN KEMP'S URINE.

1860–61.	Spec. Grav.	Quantity of Urine.	Amount of Urea.	Amount of Urea in 1000 grs. of Urine.
			grs.	grs.
Dec. 25	1011	1 pint.	148·67	3·097
„ 30	1010	7¼ pints.	206·68	2·97
„ 31	1008	9 „	267·73	3·09
Jan. 1	1010	10 „	273·69	2·85
„ 2	1007	9½ „	259·05	2·84
„ 3	1008	9 „	109·03	1·26
„ 4	1010	8 „	208·22	2·709
„ 5	1011	8 „	297·48	3·887
„ 6	1010	5½ „	224·97	4·109
„ 7	1011	5 „	272·75	5·68
„ 8	..	5 „	278·88	5·81
„ 9	..	5 „	291·28	6·06
„ 10	1013	3½ „	255·95	7·60
„ 11	1011	3½ „	303·67	9·03
„ 12	1011	5 „	402·71	8·39
„ 13	1010	5 „	266·49	5·55
„ 14	1010	5 „	322·27	6·71
„ 15	1012	thrown away.	..	..
„ 16	1010	5 „	359·45	7·48
„ 17	1011	4½ „	..	..
„ 18	..	3 „	156·17	5·42

These are, however, important to us in connection with these diseases. These matters are, I believe, univer-

Amount of Urea, &c.—(*Continued.*)

1861.	Spec. Grav.	Quantity of Urine.	Amount of Urea.	Amount of Urea in 1000 grs. of Urine.
			grs.	grs.
Jan. 19	1011	3¼ pints.	193·36	6·19
,, 20	..	3 ,,	163·61	5·66
,, 21	..	3½ ,,	190·88	5·68
,, 22	1010	3½ ,,	160·50	4·77
,, 23	1008	3 ,,	148·74	3·16
,, 24	1008	3¼ ,,	204·1	6·54
,, 25	1010	4 ,,	213·19	5·55
,, 26	1009	3½ ,,	169·19	5·03
,, 27	1008	3½ ,,	134·48	4·0
,, 28	1010	3 ,,	148·74	5·16
,, 29	1010	3½ ,,	173·53	5·16
,, 30	1010	..	..	..
,, 31	1010	3½ ,,	195·22	5·81
Feb. 1	1008	4 ,,	198·32	5·16
,, 2	1010	4 ,,	208·23	5·42
,, 3	1010	3½ ,,	208 23	6·19
,, 4	..	..	..	..
,, 5	1010	3¾ ,,	185·92	5·16
,, 6	1012	4 ,,	227·75	5·93
,, 7	1012	4 ,,	262·77	6·84
,, 8	1012	4 ,,	198·32	5·16
,, 9	1012	4½ ,,	234·26	5·42
,, 10	1010	3½ ,,	195·22	5·81
,, 11	1012	3½ ,,	177·86	5·29
,, 12	1011	3 ,,	212·02	7·36
,, 13	1010	3½ ,,	186·54	5·55
,, 14	1011	3½ ,,	216·91	6·45
,, 15	1010	3½ ,,	347·06	10·32
,, 16	1011	3½ ,,	420·81	12·52
,, 17	1011	3 ,,	319·79	10·13
,, 18	1010	2½ ,,	309·87	17·07
,, 19	..	2½ ,,	263·39	10·97

sally considered by chemists to have their origin in the metamorphosis of the tissues, and in the effete matters

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THE DIET OF KEMP DURING HIS STAY IN THE HOSPITAL.

Dec. 18	Simple (12 oz. of bread, half-pint of milk, 1 pint of gruel, and arrowroot).
,, 26	Extra 6 oz. of bread.
,, 29	Fish diet.
Jan. 22	A chop daily.

The second case (Samuel Harris, aged 39, a house-painter, admitted October 1860), in which the urea passed daily was on several occasions carefully noted, offered a perfect history of kidney disease brought on from the combined effects of cold and the inhalation of the fumes of turpentine.—He had been exposed to these causes to an unusual extent for many years, even from boyhood, but to a much greater extent than usual even with him for a prolonged period on two separate occasions. Previous to these two unusual exposures he seems to have had an average share of health, with the exception of frequent "colds," and an attack of *Colica pictorum* about thirteen years ago. He seems to have inherited a constitution free from any unusual tendency to disease, to have lived in a healthy neighbourhood, and to have been moderate in the use of alcoholic or fermented drinks. The excellent report drawn up by Mr. Harper states, that "during last winter he was in the habit of mixing paint for a great number of men who were engaged in painting a house in Grosvenor Square, and of using constantly a large quantity of turpentine. In one of the rooms, as well as throughout the house, large fires were kept up during the day to dry the paint. After being in this elevated temperature during the day, and breathing air surcharged with the fumes of turpentine, and also perhaps of lead in a minute state of subdivision and perhaps of low oxidation, on going home in the cold air of the evening he often felt chilled. Five months ago, or about the early part of May last, he was sent to Twickenham, where, he states, he was much exposed to wet and cold. Five weeks after he went there—about the middle of June—he first noticed some swelling of his ankles, and also of his face in the morning, and two or three days afterwards, he perceived that his legs and abdomen were also swelled. He then left his work and came to

which are no longer useful in the body, but ought to be excreted from it. These matters in healthy urine

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London, and applied to a practitioner. He had no pain around the loins, or in the hips or thighs, nor any scalding or pain on micturition. His abdomen at this time measured 39 inches. Two weeks ago he renewed his "cold," since which he has had considerable difficulty of breathing, and a harassing cough; but according to his account there has been but little expectoration. He has also suffered from palpitation and a slight headache; emaciation has been progressive.

He never had scarlatina.

On his admission, his countenance was pale and anæmic, and anxious; pupils small, and conjunctivæ raised and watery; lips and gums pale, the latter surmounted by a fine blue line; tongue red at tip and edges, coated along the middle; appetite moderate; slight thirst; no nausea or vomiting; abdomen tympanitic, measures on a level with the umbilicus 36 inches; pits on pressure, and its walls thickened from œdema, but no fluctuation can be detected; bowels somewhat confined; breathing oppressed; respiration 35 in a minute; has a frequent hacking cough, but scarcely any expectoration; dulness on percussion, gradually increasing from the third rib downwards on each side behind; fine sub-crepitant rhonchi accompanying inspiration and expiration, these rhonchi becoming larger on auscultating higher and higher in the chest; vocal resonance at the base louder than natural and of a higher pitch than at the apex and of a slightly tremulous character. At apex slight dulness on right side, resonance normal on left, a dry crumpling sound of emphysema heard in the anterior edge of lung on left side, pulse 116, small and compressible; cardiac dulness extends from upper border of fourth rib to lower border of sixth; transversal dulness also increased; heart sounds distant,—no murmur.

The symptoms gradually increased in severity, the anasarca increased, evidence of effiusion in the peritoneum, pericardium, and pleura became more certain, and he eventually died on the 10th of November, after being nearly a month in the Hospital.

The urine was always highly acid, notwithstanding the use of alkalies administered at various times; it had a smoke-brown colour; it let fall a copious deposit; sp. gr. 1010; and it became opalescent

vary from 10 to 16 grains in 1000. In these diseases they are reduced to from 5 to 2 grains in 1000, being

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on boiling and the addition of NO_5, and ultimately gave a precipitate in the proportion of about one-sixth of the amount of urine tested.

The copious deposit was found to consist (1) of a great number of crystals of lithic acid, possessing those forms, and the tawny colour characteristic of those most commonly, if not invariably found in Bright's Disease ; (2) of granular casts (see Plate 1) mixed with others having epithelial cells, more or less broken, upon their surface, most of them being small ; (3) larger casts seemingly epithelial, the cells being somewhat less disintegrated than in the preceding. There were but few blood-corpuscles ; the small and large granular casts were very numerous, and some contained a considerable quantity of oil (Plate I.); there were some hyaline casts observed at different times (Plate I.) ; the smoke-brown colour must have been due, therefore, to dissolved hæmatin.

He was on several occasions, during his stay in the Hospital, made to breathe on a plate of glass, moistened with pure hydrochloric acid, but it was only on one or two occasions that any crystals of chloride of ammonium could be detected by microscopical examination ; they were very small, and few in number.

AMOUNT OF UREA CONTAINED IN SAMUEL HARRIS'S URINE.

1860.	Spec. Grav.	Quantity of Urine.	Amount of Urea.	Amount of Urea in 1000 grs. of Urine.
			grs.	grs.
Oct. 18	1010	34 oz.	77·30	4·736
,, 24	1014	50 oz.	232·4	9·485
,, 26	1014	50 oz.	185·92	7·745
,, 29	1014	53 oz.	190·50	7·488
,, 31	1015	45 oz.	170·12	7·875
Nov. 1	1014	35 oz.	130·0	7·654
,, 4	1011	30 oz.	61·0	4·236
,, 7	..	45 oz.	230·0	10·648

from $\frac{1}{2}$ to $\frac{1}{8}$ the usual proportion. The fixed salts also are diminished. In health they vary in amount from 11 parts in 1000, the lowest, to 16 parts or more, the highest; while in these diseases they vary from 11, the highest, down to 1·8 the lowest. There is also a great difference in the proportion of water. In health it varies from 981, the highest in any analysis, down to 932. In these diseases that we are now considering,

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HARRIS'S DIET.

Oct. 16	Ordinary diet (12 oz. of bread, half-pint of milk, 6 oz. of meat, half-pound of potatoes, and 1 pint of gruel).
,, 24	Arrowroot.
Nov. 2	Strong beef tea (2 lbs. of meat to the pint of water) and egg daily.

The third case in which the quantity of urea has been frequently taken, and now under my care, is one of a white kidney following scarlet fever. The following are brief notes of her case :—

Mary Ann Martin, æt. 17. Admitted Feb. 17, 1861.

Short stature, light-brown hair.

Father died of phthisis ; all other relations healthy.

For the last two years has been a servant.

At the age of four years and a half she suffered from an attack of scarlet fever, which was followed by dropsy ; this passed off, and she remained in good health up to twelve months ago, when she became a patient of Dr. Thompson's for albuminuria, but unattended with anasarca. At this time she had sore throat, fever, but no eruption. This passed off, and she remained pretty well up to two weeks ago, when she suffered severely from dyspeptic symptoms, which had come on gradually, and her water has been the colour of porter and scanty. It is highly albuminous. Has been much exposed to wet and cold, as she is a nursemaid, and says her mistress would insist on her taking the child out in both wet and dry weather. Two days before admission the face was slightly puffed, but no swelling of legs.

it runs from 948, the lowest (and in this case it was in the earliest stage and the most acute form of these affections), up to 989. On the whole, the contrast in the amount of solid residue in health and in these diseases is most striking. In Berzelius it is 67·00 in 1000 parts, and in Marchand's 30 in health. In these affections it varied from 36·0, the highest, down to 10·9, the lowest. And it should be noted, in connection with this residue, that in Bright's Disease the amount is increased by the adventitious substances present,—albumen, casts of tubes, blood-corpuscles, &c.; so that the nominal amount of solid residue in these affections is greater than the real or absolute amount.

So much, then, for the alteration in proportion in the natural constituents of the urine in these affections.

On her admission, she appeared to be suffering from acute dyspepsia. Has had no convulsions.

March 6.—Purpurous spots appeared on her legs, and she complained of pain around her back. The urine has been very thick and muddy.

AMOUNT OF UREA CONTAINED IN MARY ANN MARTIN'S URINE.

1860.	Quantity of Urine.	Amount of Urea.	Amount of Urea in 1000 grs. of Urine.
		grs.	grs.
March 3	26 oz.	197·2	15·8
,, 4	30 oz.	271·45	18·85
,, 7	54 oz.	83·6	3·2
,, 8	62 oz.	147·9	4·9

What are the adventitious constituents? The first and most important is albumen. The quantity of this proximate principle is found, by the most approved analyses, to vary from 22·64 to 0·1 in 1000 parts. I need not here occupy your time in describing the manner in which albumen is detected in urine. Most of you are practically aquainted with it, and for those present who have not as yet been much in the wards, it is described in the "printed instructions" in the case-books.* It would be well, however, in some cases to weigh 1000 grains of urine, and filter, to separate extraneous matters. Then coagulate the albumen by heat, wash and carefully dry it, and weigh. You will then discover for yourselves, what was first pointed out by Dr. Christison, namely, that although the proportion as estimated by its volume in the fluid is very abundant, its weight is insignificant. Ten parts by weight in 1000 parts of urine, will render it almost a thin uniform pulp when heated. Less than this is seldom met with in the early stage of the disease. The highest amount found by Dr. Christison was 27 parts in 1000. Here, as in all similar instances, heat converted the urine into a gelatinous mass, from which no fluid issued on turning the test-tube upside down. With reference, however, to the presence of this principle in the urine, I ought to state that it has been found occasionally in the urine in persons apparently healthy. Christison found it temporarily in persons

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* See Appendix.

after eating plentifully of cheese, pastry, and other indigestible articles, which are known to have the effect of increasing the solid ingredients of the urine. He has found it, moreover, follow the application of a blister, when this happened to have given rise to renal irritation, and also when the system has been affected by mercury; but this I have never seen in my own examinations, when I have had reason to believe that the kidney was previously healthy, although I do not doubt the correctness of Dr. Christison's assertion. When I come to speak of the blood, you will find that not only is albumen occasionally present in the urine in apparent health, but that urea is present in the blood under the same healthy conditions.

Rayer has detected albumen in the urine in pregnancy, and this is the state most calculated to mislead as to its true cause, because in many cases there is more or less œdema of the feet and ankles. But, knowing as you do the symptoms of these affections, and the way in which the anasarca makes its appearance, I apprehend that you will have very little difficulty in ascribing the presence of albumen to its true cause. Many have detected this principle in the urine in the crises of some fevers, in the inflammations of the thoracic organs, in acute articular rheumatism, intermittent fevers, typhus, measles, erysipelas, and especially in cholera. In gout also it may frequently be observed. But in all these cases its presence is not permanent.

Besides the albumen and other constituents of the

serum of the blood (for I look upon it that its presence in the urine is principally owing to a simple transudation of the serum into the uriniferous tubes and Malpighian capsules), we may have blood-corpuscles and blood-casts, fibrinous filmy matters and casts of tubes, epithelium particles or epithelial and other kinds of casts, granular, fatty, waxy, and so on, and occasionally (and especially in advanced stages), puriform mucus-globules from the urethra, bladder, ureters, and even pelvis. These casts and adventitious constituents, with the exception of albumen, are only to be seen by the microscope, and to recognize them with certainty is one of the most valuable accomplishments which you can attain; and I would emphatically recommend you never to lose an opportunity of making yourselves practically acquainted with these casts—measuring their diameter, and so on. Here are diagrams of all the different forms.—(*See* Plate I.) No diagrams will convey an idea of their appearance under the microscope like that which you will derive by examining the tube-casts themselves, as well as the other constituents, the different kinds of epithelium, the tessellated and columnar from the bladder, the columnar from the ureter, the smaller and fine tessellated from the pelvis, the globular and glandular from the convoluted tubes, and the same kinds of epithelium, but somewhat flatter and more resembling the scaly variety, from the straight tubes. Of course, with this you may have both scaly and columnar epithelium from the urethra and from the vagina. It is important also to be able to recog-

nize the extraneous matters that are always found in the urine, such as cotton fibres, blanket, hair, &c.—(*See* Plate I.) But a perfect acquaintance with the casts is essentially necessary; for it is by the character of these casts, when taken in conjunction with the history and symptoms, that you will be able to discriminate the several affections which we are now considering, and which I shall describe more at length in a future Lecture.

Condition of the Blood.—The blood undergoes some very important and interesting alterations in this disease. These conditions are of the greatest importance in explaining the symptoms and secondary affections of the several diseases coming under the general denomination of Bright's Disease. The blood in the acute or sthenic affections coagulates with a thick, firm, and cupped buffy coat. There seems to be an increase of the fibrin. An interesting fact has been discovered by Simon, of Berlin, as quoted by M. Claude Bernard (Leçons sur les Propriétés Physiologiques et les Altérations Pathologiques des Liquides de l'Organisme), which in some measure may explain this. Normally we do not meet with fibrin in any secretion; and yet, if we compare the blood which enters a secreting organ with that which issues from it by the vein, it is found that its passage through the organ has produced a diminution or even a total disappearance of the fibrin. This is pre-eminently the case in the kidney. On taking the blood of the aorta and also that from the

renal vein, and whipping each quantity of blood with twigs in the usual way, it was found that while that from the aorta yielded a certain definite quantity of fibrin, none whatever could be obtained from the renal vein. This is excessively interesting and important in reference to these diseases. When we recollect the sources of the urea, namely the protein compounds, and that the kidney is incapable in these affections of separating the urea, we may be able to account in some measure for this increase of fibrin in the blood. In ordinary circumstances the fibrin is converted to some extent into albumen in the kidney. That some very important changes take place from the separation of the urea and other normal constituents of the urine there can be no doubt. It is probable—almost certain—that in health the secretion is always going on in the kidney. Bernard states, as the result of often-repeated experiments, that in the kidney and all the glands that he has already tried, when the function is going on, the blood issuing from the vein has a bright sparkling red colour (*couleur rutilante*), but if the secretion is more or less diminished or altogether suppressed, not only is the blood issuing by the vein dark-coloured, but the whole organ assumes a purplish tint, more or less deep. This change in colour may be owing to non-separation of water during the suspension of the function of the kidney. The results of Nasse's very interesting inquiries into the effects of water and other substances on the blood-corpuscles, show (what I can confirm by my own experiments) that if blood be

diluted with water, it assumes a dark red colour: if the blood be previously dark-coloured, it becomes still darker on the addition of water; and if, in these cases, the blood-corpuscles be examined under the microscope, they are found to be distended, and to have lost their discoid form, and to have become spherical. The blood collectively must therefore appear darker, since each individual corpuscle has become converted into a spherical mirror, from which the red rays are scattered and reflected. It is not unreasonable then to assume that the brightened colour of the blood of the renal veins may, in part at least, be owing to the separation of water, urea, and extractives in the kidney; and that when this separation is prevented or deficient, the blood becomes damaged and unfit for its office. Moreover, it is not surprising that the blood should be found to undergo the alterations which I have described with regard to the fibrin, the function of the kidney being impaired, as it assuredly is in these diseases. That the kidneys in Bright's Disease are incapable of producing certain changes which they have the power of doing in health, has been asserted by Bernard, on the authority of M. De Beauvais (Acad. des Sciences, 1858). It is well known that turpentine taken into the stomach, or inhaled by the lungs, gives rise to an odour of violets in the urine, and every one knows the offensive odour given off from the urine after eating asparagus. Bernard asserts that in Bright's Disease these effects are not perceived. These changes in health are effected in the blood or by the kidney, and

not in the stomach or in the lungs. If introduced into the cellular tissue, the same odour is given off.

In these acute affections the serum is usually rather turbid, and when shaken with ether, yields a small quantity of solid fat. Turbidity of the serum may be due (1) to the presence of fat in a finely-divided state; (2) to colourless corpuscles being suspended in the serum; and (3) to the diffusion through it of an albuminous substance in the form of extremely minute molecules,—Zimmerman's molecular fibrin. This last cause was first pointed out by Simon and Sherer. The morbid state of the serum in Bright's Disease may be due sometimes to one, sometimes to the other, and sometimes to all combined. In one of the three examined by Frerichs, fat was the cause; the milkiness was removed by ether: in the two remaining cases it was due to the presence of protein molecules: ether had no effect on it; carbonate of potash, nitre, &c., rendered the urine clear. The ultimate cause, according to Frerichs, is the same in both cases,—namely, diminished alkalescence of the blood, by which, in the one case, the albuminate of soda is decomposed, and finely granular albumen separated; in the other case, saponified fat is set free. The faintly acid reaction of the turbid serum supports this explanation.—(*British and Foreign Medico-Chir. Review,* page 300, vol. ix.) The decrease in the density of the serum in these acute or sthenic forms is very remarkable. While in healthy blood it is estimated at 1029—1031, it now sinks to 1020, or even 1015; and when this is the case, the proportion

of albumen in the urine is very considerable. The albumen in the urine, and the density of the serum of the blood, may to a great extent be considered as holding an inverse relation to each other. But the great and remarkable peculiarity is the presence of urea in the blood, in quantities more or less considerable beyond the healthy average. It is necessary for me to state here, as I did with reference to albumen in the urine, that urea has been detected in the blood of healthy persons. In my next Lecture I shall endeavour to show that a certain amount must of necessity be always in it. In some other diseases also, as in gout and cholera (from suppression of urine), scarlatina and erysipelas, urea has been detected; but the character of permanency in Bright's Disease, and its transitoriness in the other affections, taken with the symptoms, will show the difference.

As these affections proceed in their course, other changes are produced: (1) There is an excess of serum, the clot often constituting not more than one-fourth of the blood; (2) The density of the serum returns to its normal state, or even exceeds it; sometimes, however, it remains low, even in the advanced stages; (3) The urea disappears as the disease advances, but usually reappears towards the termination of the case, even in a larger amount than previously; (4) The fibrin, which is increased in the first stage, returns to its normal amount as the disease advances, and only becomes considerable again towards the close, or during an inflammatory complication; showing that

in some of these affections the kidney partially, if not completely, recovers the function of changing the fibrin into albumen; (5) The most remarkable character of the blood in some of the acute or sthenic forms, and in the most advanced stages of the other forms, is the great decrease of the blood-corpuscles, the quantity of which frequently amounts to only one third of the normal proportion. What causes this, in some cases rapid, and in other cases comparatively slow, diminution of the red globules, I shall endeavour to explain in a future Lecture.—(*See* Lect. IV.) The fact is indisputable; and when we consider the important *rôle* which these corpuscles play in the economy, as discovered by the researches of Majendie and Brown-Séquard, we must regard this alteration as of the highest interest and importance.

In order to put these alterations of the blood in the acute stages in a form convenient for reference, they may be generally characterized:—

1st. By an increase in the fibrin.

2nd. By a diminution in the quantity of albumen.

3rd. By the presence of urea.

In the chronic forms:—

1st. By a normal, and, under some circumstances, increased quantity of fibrin.

2nd. By a diminution of the albumen in the serum, varying in amount according to the state of the urinary excretion.

3rd. By a progressively advancing diminution of red corpuscles.

4th. By a slight increase in the soluble salts.

5th. By more or less accumulation of the excrementitious constituents of the urine.—(British and Foreign Medico-Chir. Review, vol. ix.)

In the next Lecture I shall endeavour to explain the manner in which the various symptoms and secondary affections of these diseases are produced, as derived principally from the conditions of the blood which I have now described.

LECTURE III.

RECAPITULATION. PROXIMATE CAUSE OF THE SYMPTOMS—ANASARCA.

Gentlemen,—I have in the preceding Lectures described the symptoms of these diseases of the kidney, as well as the condition of the blood and the urine. We have seen that with regard to the urine, it no longer contains the normal constituents in proportions even approaching those of health. The quantity of urea passed in twenty-four hours, instead of ranging from 250 to upwards of 500 grains, as in health (the mean for men, as stated by Simon, being 432), it ranges from 30, or even lower, to 120 grains. The quantities of fixed salts, and also of extractive matters, are likewise less than in the normal secretion.

Not only are these effete, and perhaps very deleterious substances, much reduced in quantity in the urine, and probably retained in the blood, but the urine contains, in varying but considerable quantities, many substances which ought to have been retained in the blood, and which cannot be separated from it in any great amount without detriment to this vital fluid—namely, albumen and other constituents of the serum. Microscopical examination reveals the presence, also, of other extraneous matters. We observe, for example,

several other constituents of the blood—blood in the form of casts of the uriniferous tubes, blood-corpuscles more or less altered, those large round or oval yellow bodies which may very probably be conglomerated coats of broken-down blood-corpuscles, fibrin in the form of casts and films. The microscope reveals, also, in the urine various anatomical elements of the kidney more or less degraded, showing that this organ has itself undergone, or is undergoing, some process of disorganization. It may be rapidly losing its so-called secreting elements—those elements by which the important constituents of the urine are, according to current theories, supposed to be separated from the blood, and which, I repeat, if retained in it, render this vital fluid unfitted for its great purposes in the economy, more especially for the oxidizing processes. We see, also, that the normal kidney structures are mixed with, and encroached upon by, abnormal substances—by, for example, a fibrinous, an albuminous, a waxy, or a fatty exudation. This exudation, whether fibrinous, albuminous, waxy, or fatty, could only have found its way into the urine through the urine-bearing tubes; and we cannot, therefore, avoid the conclusion that the same kind of exudation is taking place in the substance of the kidney itself. There is in these diseases, not only a transudation of the serum of the blood, but in most, if not in all of them, at one stage or another, an exudation of some determinate character. It not being unreasonable to assume that this exudation takes place in the substance of the kidney as well as in the tubes;

it is not, therefore, unreasonable to infer that the transudation also takes place in the tissues of the organ, as well as in the Malpighian capsules and uriniferous tubes, and that the kidney itself becomes in a manner dropsical.

So much, then, as to the urine; now, with regard to the blood. I showed, by chemical evidence, in my last Lecture, that the blood underwent, like the urine, very important alterations, as, indeed, we might, from the condition of the urine, have expected. In all cases, however, it is better to rely alone, or as much as we can, upon the result of absolute examination. The blood, as we have seen, is deteriorated; the water is too abundant; the serum is not the serum of health, it is less dense, and is increased in quantity; the clot is not only much reduced in volume, in proportion to the serum, but it is soft, and often covered with a buff-coloured coat; the fibrin is increased, but probably it also is not the fibrin of health; and the red blood-corpuscles are no longer capable of going through the normal changes of development, growth, and decay. The process of red-blood formation is impaired, in some cases perhaps arrested; for while the proportion of white corpuscles is much increased, that of the red corpuscles is greatly diminished. When we consider the successive changes which these important bodies are generally supposed to undergo from lymph, chyle, white corpuscles, up to the perfect red corpuscle, and the important part which these red corpuscles play in nutrition, secretion, respiration, and excretion, we are

prepared to expect that these alterations in them, together with those of the blood in other respects, will not be without their effects upon the system; and we need be at no loss, therefore, to account for the anasarca, the emaciation, the pallor, and other symptoms, as well as for the secondary affections which I described in a sort of classified order in my first Lecture. But in addition to these alterations in the natural proportions of the normal constituents, there are present, in variable, but always in considerable quantities, highly stimulating, irritating, perhaps toxic matters—pure excrement, which can never be retained in the blood without more or less disastrous effects upon several great vital processes of the economy, and if generated in large quantity suddenly, or if intercepted in their way out of the system through other channels, lead rapidly to death.

Without, then, stopping now to inquire into the condition of the blood or of the system, which has given rise to these changes in the kidney itself (for that I shall do at length when I come to speak of the causes of these affections), I will at once proceed to explain the mechanism of the symptoms—the proximate causes of the symptoms; these being of themselves almost diseases.

The first symptom that I placed in my classified list, because of its importance, was Anasarca. It may be asked where, in the majority, at least, of these affections—probably in all the acute affections—does the anasarca begin? If we were carefully to examine the serum effused in the subcutaneous cellular structures,

in the serous cavities, and in the parenchyma of organs in dropsy from other diseases or conditions, we should probably find nearly, if not all, the constituents of the blood that are present in the urine and in the kidney itself in these affections. These effusions, it is well known, may vary from simple transudation of the serum of the blood, to an exudation of more solid substances; for example, fibrin in the different states which it assumes in different constitutions and in different individuals. A very trifling difference in the cause of the retardation of the circulation through the kidney, either in its intensity or quality, will change a transudation of serum, with more or less of hæmatin, and richer or poorer in albumen, into an exudation of fibrin and other solid matters. The researches of Schmidt have proved that the transudation will be richer in albumen in proportion to the slowness with which the blood passes through the capillaries. We know also that the richer or poorer the blood is in albumen, so in proportion will be the quantity of this proximate principle in the transudation. Well, then, we find, even at the commencement of these acute affections, these constituents in the urine; and this is a certain evidence of the presence of effusion, or transudation, or exudation, as the case may be, of the same matters in the structures of the kidney itself. A certain cause of retardation of the blood through the kidney is in operation—it may be alcohol, it may be some long-continued suppression of the cutaneous function, or the poison of scarlatina, or of gout, or rheumatism, or poor

watery blood from insufficient food or inherent vice of constitution—it may be some irritation of the kidney itself, or of its nutrient nerve, or of that part of the nervous centre which is more immediately connected with the well-being and secretion of the kidney (Bernard has shown that it is somewhere in the medulla oblongata); but whatever the cause in operation may be, this very retardation is attended with congestion, and, when combined with other circumstances, favours or leads to transudation to a varying extent, of different constituents of the blood in the kidney itself, as well as in the Malpighian capsules and uriniferous tubes;—the kidney, in a word, becomes dropsical, anasarcous, and œdematous. What do you often see when you take up a kidney which has been removed from a person dead of acute anasarca, or some other of these affections, and which has been opened in the usual way? You find a large, flabby, more or less sodden, watery kidney,—a kidney nearly, if not quite, twice as large as it is in the natural state; serosity drops from it in large quantity as you make a section of it; the vessels are filled, turgid with thick red blood that has been deprived in great measure of its serum. It is certain that this œdematous condition of the kidney precedes the general anasarca, a local œdema produced by a specific cause, as the general anasarca is produced by a general cause, as a result of the kidney affection. Don't mistake me, and come to the conclusion that I intend to say that Bright's Disease is a mere dropsy of the kidney, although, in one sense, it would not be

altogether very wide of the truth to say so. When I come to speak of the several states of the kidney known as Bright's Disease, you will, I think, find that there would be some little approach to truth in such an assertion, modified according to the nature of the several causes producing them. There would be some truth, I repeat, in such an assertion, but it would not be the whole truth. In some cases there is a transudation of serum only; in others one of serum, coagulable lymph, and blood-corpuscles; in others, again, of fibrin, of albuminous matter, of fatty matters, and lastly of a kind of matter which, when freshly exuded, either is, or becomes in a longer or shorter time, waxy, inorganizable. Now these remarks as to the condition of the kidney are not out of place here, entering, as I am, upon the description of the proximate causes of the general anasarca, especially when I am addressing for the most part pupils of three years' standing, and some still older, now present. For what occurs in the kidney, as I have described it, takes place, for the most part, in the areolar tissue throughout the body, in the great serous cavities, and in the parenchyma of organs which are involved in the dropsy; and the application of any efficient cause—a current of cold air, for example, to any part of the chest—will convert the transudation of pure serum into an exudation of what are called inflammatory products.

Proximate Cause of Anasarca.—Various causes are in operation in the production of anasarca from kidney

disease. That which is the result of the acute affections—when dropsy comes on rapidly in a few hours, and is almost the first indieation of the disease—is not probably produced by the same eauses as those which, singly or in eombination, are so influential in the production of anasarea in the more chronie forms. The same may be said with regard to the nervous symptoms. There is no doubt that a eause suddenly eoming into operation, before the system is in a manner prepared for it, may be produetive of consequences whieh, if it eame on, or aeted, more slowly, so as to allow the system to accommodate itself to it—to aequire a toleranee for it—would not be of any serious nature. It may not be the same poisonous substanee in the one case as in the other. Unfortunately we know nothing for eertain with regard to whether urea as urea is a poison. Some allege that it is so, but only in eonsidcrable quantities; others affirm that only the salts into which it is prone to be eonverted are poisonous. Some, again, assert that in the blood it always exists as urea, and becomes converted into different salts of ammonia by a ferment, when passing through mucous membranes, or shortly after it has passed through them. The experiments of Dr. Hammond, of Philadelphia, which were condueted with great care, conclusively prove that urea, when retained in the blood, either by disease or extirpation of the kidneys, is highly poisonous, and is sure, sooner or later, to kill; for however strongly the experiments of Bernard tend to show that after extirpation of the

kidneys the lives of the subjects of his experiments were preserved for some days by the elimination of the urea by the mucous membrane of the stomach and intestines, under the form of salts of ammonia, yet the animals invariably died as soon as the stomach became no longer capable of performing this vicarious office.

Dr. Hammond's experiments are of such great importance, and prove so conclusively the poisonous nature of urea, that I shall make no excuse for detaining you a few minutes in stating the results of them. I know that you are aware (for I have always mentioned it in my systematic Lectures here), that Wœhler and Frerichs explained the uræmic intoxication by supposing that the urea is converted, through the agency of a ferment, into carbonate of ammonia in the blood. Dr. Hammond was induced to perform his experiments for the purpose of deciding upon the correctness of this theory. The experiments upon which Frerichs founded his theory were these :—In the first series he injected a solution of urea into the blood of animals whose kidneys had been previously removed. In from an hour and a quarter to eight hours they became restless and vomited. Ammonia was detected in the expired air, and simultaneously, convulsions ensued. Death occurred in from two and a half to ten hours from the commencement of the experiments. Ammonia was found in the blood, the contents of the stomach, and in the bile and other secretions. In the second series a solution of carbonate of ammonia (quantity not

stated) was injected. Convulsions ensued almost immediately, and were quickly followed by stupor. The respiration was laboured, and the expired air was loaded with ammonia. This substance, however, gradually disappeared, and the animals recovered their senses.

With regard to the ammonia discovered in these cases, it must be mentioned that it has been found in the expired air and in the blood of healthy individuals, and that, on the other hand, it frequently cannot be detected even in persons dying of Bright's Disease, when the urinary secretion has been in great part, if not quite suppressed. Some of you have seen the experiments tried in the wards, by means of a glass plate wetted with hydrochloric acid, without discovering a trace of ammonia.

Dr. Hammond's experiments also consisted of two series. In the first, the substances were injected into the blood of sound animals; in the second, the kidneys had been previously extirpated. The substances injected were urea, urea mixed with vesical mucus, carbonate of ammonia, nitrate of potash, and sulphate of soda. I shall only give you the results of those made with the three first. They were injected into the jugular vein in drachm doses, dissolved in four ounces of distilled water; and in the case of the second experiment, the urea was mixed with 115 grains of the mucus. All the animals exhibited some uneasiness soon after the injection, with slight spasms of the limbs, followed by a disturbed sleep of two or three hours' duration; and on awaking out of it, they passed

a larger quantity of water, soon after which they were as well as ever. The carbonate of ammonia seemed to produce more immediate and violent symptoms, but yet the animal speedily recovered. In the two experiments with urea, the dogs passed a much greater quantity of water after than before the injection, and also an increased quantity of urea, amounting to within about six grains of that which had been introduced into the blood. No ammonia could be detected in the expired air or in the water; while in the case of the injection of the carbonate of ammonia it was detected in both. In these experiments the urea produced some symptoms of poisoning, but in consequence of its speedy elimination by the healthy kidney, they quickly subsided, and the animals recovered. Much the same results have been observed with regard to other poisons. When, for example, arsenic, in no very large dose, has been taken into the stomach, and it has been speedily removed by vomiting. Symptoms of poisoning may have been present before the vomiting took place; but after the removal of the poison by vomiting they have gradually subsided. But let the poison remain, by the absence of vomiting in one case, or the suppression of the excretion in the other case (with urea), and the symptoms will continue, and death more or less speedily supervene.

In the second series, Dr. Hammond, previous to the injection, extirpated the kidneys, and after the animals had completely recovered from the effects of the operation, and appeared lively, the same substances, in

precisely the same quantities, were injected. In from forty-five minutes to an hour after the urea had been injected, the two dogs were seized with convulsions, which continued, with alternations of stupor, from six and a quarter to eight hours, when they died. There was no vomiting, no ammonia in the breath, nor any ammoniacal odour perceived in the examination of the bodies after death. Pretty nearly the same symptoms were observed after the injection of the carbonate of ammonia, and death occurred in about the same time. The symptoms came on somewhat earlier, and there was vomiting. Ammonia was detected in the vomited matters, and in the breath.*

The condition of the system after extirpation of the kidneys is in many respects analogous to that present in Bright's Disease. In many cases, especially in the early stages of the acute forms, and in the later stages of the chronic forms, there is almost a suppression of the secretion. The statements of Dr. Rees and others, that urea has been found (and these are very exceptional cases) in the blood in large quantities, when no very evident symptoms of uræmic poisoning have been observed, ought not to weigh against such evidence

* In a monograph which Dr. Hammond has been so good as to send me, and which is a reprint of a paper communicated to the American "Journal of the Medical Sciences" for January, 1861, there is a very interesting account of some further experiments made by Dr. Hammond which confirm in every respect the conclusions drawn from those above recorded.

as this. In the case mentioned by Dr. Rees, the kidney disease may have come on so slowly as to afford time for the system to acquire a tolerance for the poison. There is no reason why a tolerance, to some extent, may not be slowly acquired for this, as we know it to be acquired for other undoubtedly poisonous substances. As I stated in my last lecture, urea is always present in healthy blood. It must of necessity be so. No physiologist, I believe, denies that the urea is merely separated from the blood. It is universally acknowledged now-a-days that the kidneys have no converting power. It cannot be supposed, therefore, that all the urea contained in the blood goes directly to the kidneys; and, therefore, it follows that only that quantity which passes through these organs is freed from this excrement at every successive revolution of the circulation. The following calculation will show this clearly. We will take the case of a healthy man, excreting every twenty-four hours about 360 grains of urea. This quantity divided by 24 will give 15 grains every hour, and still further reduced, $\frac{1}{4}$ of a grain every minute. We will suppose the quantity of blood in his body to be 30 pounds, and that it takes from a minute to a minute and a half to complete the circulation. We will suppose, moreover, that the kidneys constantly contain about three ounces of blood, and that about five ounces pass through these organs every minute. As we get, then, a quarter of a grain of urea from the five ounces passing through the kidneys during this space of time, it is reasonable to infer that there will be

left in the remaining mass of blood (475 ounces) $23\frac{3}{4}$ grains of urea. *

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* The quantities which I have conjecturally assumed are in one case too small, and in the other too large. In one of the very elaborate tables in Dr. Parkes's most excellent and useful work on the urine, it appears that the mean amount of urea secreted by males in twenty-four hours, as furnished by 250 analyses made by twenty-four eminent chemists, is 512·4 grains, ranging from 286·1 grains the lowest, to 688·4 grains the highest; and in females from 260 to 400. The amount of blood (30 lbs.) is more than the area of the heart and blood-vessels in a man of average size can accommodate, notwithstanding that it is the quantity as calculated by eminent physiologists. The amount of blood expelled from the left ventricle at each contraction, as supposed by Valentin (5 oz.), and Volkmann (6 oz.), is probably too large. I have made my calculation on the supposition that at each contraction of the left ventricle from $2\frac{1}{2}$ to 3 ounces of blood are expelled, and that of the wave of blood so thrown into the aorta, from half a drachm to a drachm is propelled into the kidney, and that the same quantity makes its exit simultaneously by the vein. Supposing, then, that there are from seventy to seventy-five ventricular contractions in a minute, the total quantity passing through the kidney during this space of time will therefore amount to from 5 to 8 ounces. But as to the quantities, it matters not for my purpose. It is not the exact quantity which I wish to show is always in the blood, but that there necessarily must be some urea constantly in it, and more than is generally supposed. The excretion of urea is always going on more or less quickly, and the formation of this substance from the waste of the protein tissues, and from the same principles in the food in greater or less quantity, according to the state of the body as to exercise and food, and its transmission into the blood through its principal conduit, the thoracic duct,† is also constant, it follows that there must be more or less of urea in the blood at all times.

With respect, also, to the length of time required to complete the circulation, some facts of importance have been omitted in the calculation. Now that we have more correct notions with respect to secre-

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† M. Wurst, as quoted by Bernard.

Not only has it been shown by experiments that urea is poisonous when introduced into the blood, but M. Gallois has detected its poisonous properties when injected into the stomach. He injected urea (about five drachms) into the stomach of rabbits, and he found that it became absorbed, and passed through the circulation, and was excreted by the kidneys as urea, and that the animals died, all having exhibited the same symptoms. These were—acceleration of the respiration, weakness of the limbs, tremblings and startings of the muscles, general convulsions, tetanus, and death.

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tion, most physiologists will allow, that although a complete revolution of the circulation may be effected in from a minute to a minute and a half, as derived by calculation (Valentin and Volkmann), and by experiment (Poiseuille, Bernard, and Blake), the blood really moves with different velocity in different secreting and excreting organs, influenced as the circulation is probably by the peculiar affinities and the diameter and arrangements of the capillaries and other minute vessels. We observe that every secreting organ has some peculiarity in the arrangement and size of these vessels, and in the thickness of their walls. This arrangement must affect, to some extent, the velocity of the circulation, and affect also the character of the blood plasma transuded into the tissue, from which the secreting agents are to separate the peculiar constituents of the secretion. Taking the double circulation of the blood in the kidneys into consideration, then, it is probable that the blood does not pass through them so quickly as through some other organs, and that the whole mass of blood does not really pass through the heart every minute or minute and a half, although a quantity equal to it may do so ; some portions may, in fact, pass twice or oftener through the heart in this space of time.

On the assumption that there are 20 lbs. of blood in a man's body, and that an ounce and a half of urea is excreted in twenty-four hours, Marchand calculated that the blood contains the 15-360ths part of its weight of urea.

Making allowance for the animals operated upon—rabbits,—these symptoms resemble in many respects those which we observe in the human body in rapid poisoning by uræmia. No vivisector or experimental physiologist has either extirpated the kidneys, tied the renal arteries, destroyed the renal nerves, or in any other way arrested the renal functions without producing the symptoms of uræmic poisoning. But in all the cases of removal of the kidney the animals survived for several days, and the symptoms were not observed for a considerable time after the operation. In those, however, in which the urea had been introduced after extirpation, the symptoms invariably came on within the hour, and death occurred in from six to nine hours. But apart from the results obtained by chemists, vivisectors, and experimenters, the practical Physician has constantly irrefragable evidence in cases of acute anasarca, of the undoubted poisonous influence of the urinous excrement when retained in the blood.

Having come to the conclusion that either urea itself (as I am led to believe) is poisonous, or that the urea and extractives together are so, in what way do they act in the production of anasarca? I cannot agree with Frerichs in the opinion that acute dropsy—that after scarlatina, for example—has the same cause as the kidney disease, and that it is in consequence of the paralysis of the capillaries of the skin and subcutaneous tissues excited alone by exposure to cold. I do not believe that there ever was a case of general dropsy from mere exposure, unless the kidney had first suffered

from the exposure, and its function been more or less suppressed. I have already indicated the order in which I think the dropsy most commonly, if not invariably, occurs, whether after exposure to cold or from any of the other causes of kidney affection leading to dropsy. In the acute forms it is one single poisonous substance which produces what has not been inaptly termed inflammatory dropsy, as well as the more severe nervous symptoms which we witness. There are two ways of explaining the *modus operandi* of these agents, or rather of this agent, in causing dropsy. The circulation is undoubtedly retarded, perhaps arrested altogether, in some parts of the capillary system. Most probably it is in the venous capillaries that this retardation takes place—that which is furthest removed from the influence of the cardiac impulsive pressure, and the constant arterial pressure. One way in which the uræmic poison may act is by directly affecting the capillary vessels themselves, relaxing their walls, and converting them in a manner into inert tubes. We all know the effect of this condition in delaying the passage of fluid. Poiseuille, Bernard, and others, have shown by hæmadynamometers, manometers, and cardiometers, that fluids of all densities take a longer time in traversing relaxed inert tubes, than tense, elastic, and contractile tubes.

The other way of explaining this effect upon the capillary blood-vessels is by supposing that the poisonous agent in operation first affects the nervous system, and by destroying or impairing its influence upon these

vessels, relaxes their walls, and interferes with the circulation mechanically in this way, and in addition, retards it by preventing the action of the chemical affinities which we all know to be so influential in carrying on the circulation through the capillary system. Bernard and other experimenters have shown most conclusively by experiments, that division, or even irritation, or prolonged galvanic excitation, invariably increased the arterial pressure in the vessels going to the parts suppled by the divided or irritated nerves. This increase of pressure is doubtless owing to the retardation of the capillary circulation, the paralysis of the minute vessels, and the division or irritation of the nerves, and consequent arrest of the action of the *affinities.* These *affinities* exert an undoubted influence in promoting the circulation through the capillaries and veins. It is very probable, indeed, that the circulation through these vessels is entirely due to the action of these *affinities,* as suggested and ingeniously explained by Professor Draper.* From certain very cogent facts, this gentleman believes that the action of the heart does not extend beyond the arterial origin of the capillaries. "The relation between the interspaces of the capillaries and the blood thus introduced to them continues the current. The particular mode in which this relation is manifested differs in different parts.

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* Human Physiology, Statical and Dynamical. By John William Draper, M.D., LL.D., Professor of Chemistry and Physiology in the University of New York, page 145 *et seq.*

The oxidizing arterial blood has a high affinity for those portions that have become wasted: it effects their disintegration, and then its affinity is lost. The various tissues require repair; they have an affinity for one or other of the constituents of the blood; they take the material they need, and their affinity is satisfied; or secreting cells originate a drain upon the blood, and the moment they have removed from it the substance to be secreted, they have no longer any relation with it. So processes of oxidation, and processes of nutrition and secretion, all conspire to draw the current onward from the arteries, and to push it out toward the veins; and though these processes may present themselves in many various aspects, they are all modifications of the same simple physical principle."

By one of these ways, perhaps by both combined, the transmission of the blood through the system is delayed—the red corpuscles accumulate, the vessels become distended, and their walls attenuated. During this condition, the heart is acting tumultuously from the general inflammatory erethism present, and it is constantly propelling greater quantities of blood into the arterial system. You know the effect of all this. The blood in the arterial system is inclosed and pressed in canals, more or less elastic, more or less muscular; it cannot recede because of the valves of the heart, and it is only able to escape by traversing the narrow minute capillaries. Although the sum of these capillaries may be greater than that of the arteries with which they are continuous, yet anything which arrests

or impedes the circulation through these capillaries, or the veins beyond, must augment the arterial tension—the arterial pressure. The force, then, with which the blood is pressed against the capillaries, distended as I have shown them to be, by the action of the uræmic poison upon them — whether directly or indirectly, mediately or immediately,—must inevitably lead to one of two things: either the escape of the serous part of blood, or that of the blood itself. If it be serum alone, there is anasarca; if blood, there is hæmorrhage.

A very interesting case, illustrating the transudation of serum in some parts and of blood in others, from evident uræmic poisoning, we have lately seen in this Hospital. The young woman was admitted with epileptiform convulsions occurring at intervals varying from five to fifteen minutes, each of which lasted from two to five minutes, and was followed by complete coma until the next paroxysm. In this state she continued until the evening of the same day, when she expired. So far as we could ascertain the particulars of her illness from the woman who brought her to the Hospital, and with whom she slept, it appears that on the evening preceding her attack, she complained of headache, and general indisposition. She had a foot-bath before she went to bed. In the morning the woman on getting up found her sleeping heavily, and snoring loudly, and as her attempts to awake her were unsuccessful, she allowed her to sleep on. On returning a short time afterwards, she found her much convulsed; there were constant twitchings and startings of the muscles of the face, as well as

those of the whole body, and there was a eonsiderable quantity of bloody froth issuing from her mouth, and when the attack went off, she remained insensible until the next cpileptiform paroxysm, much the samc, in fact, as after her admission. On her admission she was found to bc far advaneed in prcgnaney, and there was evidence of a puriform diseharge from thc vagina. I may add that this poor girl arrived in London from Exeter about a fortnight bcfore her illness, and had been much exposed to the sharp eold weather that prevailed during that time. There is reason to believe that her nightly aeeommodation was not very efficient for securing adequate protection from the eold. At the *post-mortem* examination of the body purpurous spots were observed on the backs of the hands. There was eonsiderable hæmorrhagie effusion under the arachnoid, in the meshes of the pia mater, especially on the right side; the gray substanee was very dark, the white substance sodden and softened; purpurous spots were sprinkled all over the surfaces of the perieardium, visceral pleura, and eapsule, and substanee of the liver. The perieardium eontained about two ounees of bloody fluid; heart fatty, otherwise normal. The lungs were gorged with blood, presenting many spots, some of very eonsiderable size, of pulmonary hæmorrhage, the tissue containing whieh sank in water; liver large, fatty; kidneys—eapsules slightly adherent, eortieal portion pale, and larger than usual; pyramids of normal appearanee to the naked eye, but the eortieal portion presented a yellow appearance. Under the microscope

the tubules from both portions appear filled with granular matter, and the matrix contains a large quantity of recent areolar tissue. Both kidneys were much increased in size; spleen very large and flabby. Here there was a case of undoubted uræmic poisoning from certainly one, perhaps from two causes; the kidneys were in a great measure unable to perform their function from the diseased condition in which they were found; the effects might also have been, and very probably were, increased by the pregnancy. In first pregnancies, you are perhaps aware, there is always greater danger from convulsions—that is to say, convulsions are much more frequent than in succeeding pregnancies. This has been explained by the unyielding nature of the abdominal walls in first pregnancies, perhaps aided by the new condition in which the system generally, and also the surrounding parts, find themselves for the first time. The unyielding nature of the abdominal walls is certainly calculated to increase the pressure of the uterus upon the blood-vessels and nerves behind this organ, and in this way interfere with the circulation, and lead to engorgement of the kidneys, the pelvic organs, and the lower extremities. Be this as it may, here we have the strongest evidence of the retardation of the capillary circulation as the direct or indirect effect of the retained urinary excrement. The arterial tension and pressure consequent upon this, together with the cardiac impulsive pressure, so distended the small arterial tubes and the capillaries, as to lead to the extravasation of blood either by transudation

through the attenuated walls, or by actual rupture, perhaps in some parts by one, in other parts by the other condition. It must be observed that there was considerable subcutaneous œdema.

The anasarca in the acute form of these affections varies in many respects from that observed in the chronic forms. The serum transuded is much richer in albumen. The anasarca has come on before any great amount of this principle has been thrown out by the kidneys—while the blood is rich in albumen; and it has been discovered by Schmidt as almost a law in the transudation process, that the quantity of albumen contained in the transuded serum is in a ratio to the quantity contained in the blood. There is every reason to believe that some fibrin is also transuded. The œdematous parts do not so readily pit, and the indentation from pressure more readily disappears. There is more elasticity, in fact, in the dropsical tissue. In addition to these physical differences, the anasarca is always accompanied by a more or less inflammatory erethism —constituting the inflammatory dropsy. Both in the acute form of anasarca as well as in the chronic variety, the dropsy is general. You will have no difficulty in explaining this. The cause is general; it is in operation in the whole capillary system of the body, and therefore affects the whole of the tissues, to a greater or less extent, simultaneously. I say to a greater or less extent, because, although the whole of the capillary circulation is affected, the effects are not manifested to the same degree. There is another general law with

regard to transudation which is applicable here, not only as to the quantity of albumen in an effusion, but as to the tendency in particular sets of capillaries to effusions. Schmidt found "that the transudation from every group of capillaries contains a definite and constant quantity of albumen," and observation shows us that that system of capillaries which pours out less albumen in the effusion is most prone to transudation when any cause is in operation to produce a retardation in the circulation. Schmidt found, then, the transudation in the pleura to be richest in albumen (=2·85%); that in the peritoneum considerably poorer (=1·13%); that within the cranial membranes yet more deficient (0·6, or at most 0·8%); and that in the subcutaneous areolar tissue the poorest (=0·36%). That there is a considerable approach to truth in these proportions must be admitted, inasmuch as these analyses were made from effusions taken from the same individual, who was suffering from Bright's Disease. Another circumstance may be mentioned here in connection with anasarca; it is, that the looser the tissue the more likely is it to be the seat of œdema.

So much, then, for the proximate cause of anasarca, as it occurs in the acute forms of these diseases—sthenic, acute anasarca—which I have attempted to show is dependent more on the matters retained in the blood, and the inflammatory erethism which they exert, than to other physical qualities of the blood. The proximate cause of the same symptoms in the chronic forms is more multifarious; both the physical and

chemical qualities of the blood are now altered, as well as the relation which they bear to the extra-vascular fluids. These relations of the fluid within the vessels to those without the vessels have been too much overlooked in explaining the proximate cause of dropsy, chronic or asthenic anasarca, as we may term it. The blood in its ordinary healthy condition is admirably adapted with respect to density and composition for producing and maintaining an endosmotic current, and in this way to favour or promote absorption rather than effusion. As has been well observed by Lehmann, "We find united all the conditions for rendering the circulating system by means of the blood, a most perfect suction-pump, which performs its duties without stop-cocks or valves, without mechanical pressure, nay without regular canals or passages for the transmission of the fluids." The blood-corpuscles—white and red, as also those of lymph and chyle, are well adapted for exciting and maintaining an endosmotic current in the circulating channels themselves. So far, then, as mere density alone is concerned, especially when aided by its chemical and anatomical composition, the blood is admirably fitted for preventing any osmotic current *out of* the blood-vessels; and were it not for the constant arterial and impulsive cardiac pressure exerted upon the arterial capillaries, there would probably be no transudation outward of the *liquor sanguinis* for the nourishment of the tissues. In dropsy, however, especially in the condition of the blood as we find it in the chronic forms of Bright's Disease, this arterial

pressure drives out more than is wanted for the system, and a fluid ill adapted for its wants. And not only this, the blood at the same time is deprived of those properties and that composition which are calculated to set up or maintain an osmotic force in the opposite direction, in a manner so well described by Lehmann. We have found the blood, in these chronic forms of Bright's Disease, poor, thin, watery, containing much less albumen, less red corpuscles, than in health, and also containing extraneous, offensive matters—urea and the extractives. As I have shown, there is always a small amount of urea in at least that part of the blood which lies in the large veins, the heart and lungs, and especially in the lymphatics on its way to the blood; but it is reasonable to suppose that this small quantity is much less prejudicial than a sudden and great accumulation from partial or complete suppression of the secretion, as in the acute forms, or from the gradual and long-continued retention in the whole circulating system, as we find it in the chronic forms. This poor, thin blood, containing, as it does, more or less urinous excrement, is ill adapted to facilitate the circulation. On the contrary, its inevitable effect must be to retard the circulation. Poiseuille and all other experimenters upon the circulation have clearly shown this. It is well known that a great increase in the proportion of water alone has a tendency to produce œdema. It has been produced artificially by the injection of water into the blood-vessels. Poiseuille attempted to pass water through the capillary network of an organ (as I have

often done with the same result), and he found that the water injected into the artery did not return quickly by the vein, as it did and does in the case of glutinous saline injections, but a great part of it escaped into the tissues, and produced infiltration there—a dropsy, in fact. On adding albumen to the water, or employing normal serum, this infiltration did not occur, showing clearly that the albumen alone, when in normal quantity, may hinder, to some extent, the effusion; and it is absolutely necessary that the albumen should be in sufficient quantity, for if the water be in excess, the fluid will still infiltrate through the tissues. It shows, at least, that the absence or great diminution of albumen is eminently calculated to favour the escape of serum through the attenuated capillary vessels. Bernard and Poiseuille have both observed that fibrin, when in intimate mixture with a due and normal proportion of albumen, facilitates the movement of the blood; but if the fibrin be withdrawn, the blood-globules fall to the most dependent part, and obstruct the capillary circulation. "When we," says Bernard, "examine under the microscope the capillary circulation in the web of a frog's foot, we see the globules suspended nearly uniformly in the serum. But if we examine this circulation in an animal whose blood has been defibrinated, we see the globules fall to the most dependent part, whilst at the superior parts pure serum alone circulates. If a horizontal vascular trunk bifurcates in two divisions, not situated on the same horizontal plane, the lower branch will be plugged by

the accumulation of the globules, while the upper branch will be full of serum." Although there is an excess of fibrin in some of these states, yet there is a great diminution in the proportion of albumen, which doubtless holds it in solution, and it is probable that this excess of fibrin is by no means calculated to promote the circulation in the way stated by Bernard. The altered fibrin is much more likely to coagulate spontaneously in the living body, and in this way actually to add another impediment to the free transmission of the blood through the capillary system. The fibrin in these cases of Bright's Disease—in this asthenic form of anasarca, resembles probably that alteration which takes place in it when the blood has been rendered thin by repeated bleedings. Although the proportion of fibrin is evidently increased by bleeding, yet, according to the observation of M. Frémy, it is very much altered in quality. The fibrin in the blood taken by the first bleeding is filamentous, elastic, and resisting; but that which is in the blood taken after repeated blood-lettings, becomes less and less elastic, and acquires a soft consistence, and is rapidly dissolved in tepid water. The fibrin after these repeated bleedings has not arrived at its full stage of perfection, for want of time. The same may reasonably be said of this principle in this disease, from the presence of urinous excrement and from want of the normal proportion of albumen.

I repeat, then, that seeing the condition of the blood in chronic, asthenic anasarca, the cause must be mani-

fold. In the first place, the paralysing influence of the urinous excrement upon the heart, the smaller arteries, and the capillaries, although smaller in amount and less virulent in quality than in sthenic anasarca, cannot fail to produce a retarding influence, especially upon the capillary circulation; secondly, the watery, inelastic state of the blood itself adds another element to increase this retardation; and thirdly, the lax condition of the smaller arterial branches and the capillary vessels from innutrition, the direct result of the circulation through their nutrient arteries — the vasa vasorum—of thin poisoned blood, adds another contribution to this delay in the blood circulation; all these causes, combined as they are in the chronic forms of the diseases which we are now considering, lead to distension of the capillaries and small venous radicles, and thinning of their walls. But with all this, if the blood had been healthy, probably there would be no dropsy. You see every day in the Wards varicose of enormous size, with coats thinned, and ready to give way at any moment, and yet no œdema. The blood is, in a manner, healthy in this case. If, however, the blood be thin and watery as in these affections, the serum transudes more or less rapidly, and in some cases with enormous rapidity.

These, then, are the proximate causes of asthenic dropsy.

LECTURE IV.

CAUSES OF THE PALLOR AND THE SYMPTOMS REFERRIBLE TO THE DIGESTIVE, THE NERVOUS, THE RESPIRATORY, AND THE CIRCULATORY SYSTEMS.

GENTLEMEN,—The next symptom in our classified list is pallor; and as other symptoms (*e. g.* emaciation, and those referrible to the nervous, respiratory, and digestive systems) are more or less intimately connected with the proximate cause of this symptom, as well as of those of which I have already spoken, I will include what I have further to say with respect to these symptoms in my remarks on the cause of the pallor.

A general paleness or anæmic appearance of the surface, as well of the skin as of the mucous membranes, is almost always observed in these diseases. It indicates a true hydræmia. This sign is not of much value in the acute forms of these diseases. In the chronic forms, however, especially in those in which no albumen can be discovered in the urine, it is a symptom of great value, and when observed in persons above the age of from thirty-five to forty, it should lead us to examine closely for the detection of the other symptoms and conditions which are characteristic of these forms of disease. Especially should we direct our attention to the specific gravity of the urine, the quantity passed

daily, and the amount of urea contained in the daily discharge. It should lead us to observe also more carefully than we otherwise should feel called upon to do, the state of the eyes and eyelids,—whether there be not a slight puffiness of the eyelids in the morning, whether the eyes be not preternaturally pale, and there be not some indication of serum beneath the conjunctivæ. In persons exhibiting this anæmic appearance, even when there is no perceptible general dropsy and no albumen in the urine, you will generally find, by moving with some slight pressure the eyelids up and down upon the conjunctiva oculi, that you can make the appearance of a tear from the fluid collected beneath the membrane. The paleness in these diseases is not like that in chlorosis, or in anæmia from other causes, a dry waxy paleness; it is what may be called a dropsical paleness; and there is generally some amount of swelling or fulness of the integument, although there is no "pitting" on pressure. The urine also will invariably be of low specific gravity, seldom above 1010, often below this, and very pale in colour and somewhat turbid. Of course I need not again take up your time in telling you how to discriminate between the anæmic appearance from this disease and that due to phthisis and other diseases. But even if there be unmistakable evidence of phthisis in any case, this ought not to exclude the fact that kidney disease may be present also. The phthisical state may have been rendered active or hastened, in one having an hereditary or acquired tendency to it, by the innutrition of the body, conse-

quent on the kidney disease, as I believe it often is. Bearing in mind the symptoms and secondary affections, and especially the condition of the urine in these affections, you need never be at a loss in making your diagnosis. In the practice of your Profession I am sure you will find the benefit of paying great attention to these symptoms; you will often discover strong evidence of kidney disease before the appearance of the albumen; for I am confident that the kidney often undergoes a very serious amount of disease before this principle can be detected in the urine. In many cases you may be asked whether an operation for the removal of any disfigurement might be undertaken with safety which might be allowed to remain without injury to the health. Of course, if this, as well as the other symptoms of chronic kidney disease be present even when no dropsy can be discovered, and no albumen in the urine, you will give the weight of your opinion against the operation. In other cases you may be enabled to explain why accidents, not serious in themselves, are followed by fatal consequences.

Proximate Cause of the Anæmic Appearance, Emaciation, etc.—My description of the proximate cause of the pallor will not be so satisfactory as I should like it to be. At present we know very little as to the direct influence which urea exerts upon the red corpuscles under different conditions of the serum, more especially those which we find in Bright's Disease. My friend and colleague Mr. Heisch and I have been engaged for

some time past in making experiments and observations with the view of discovering how urea acts as a poison, and more particularly how it affects the red corpuscles; but as yet the results do not justify our laying them before the Profession. That it does exert a considerable influence upon the red corpuscles, under certain conditions, there is no doubt. I will not occupy your time in giving the results of others, because, as I think, they are not borne out by subsequent inquiries. We have seen that, in all the forms of these diseases, there is a great diminution in the proportion of the red globules. How can we account for it? It will be necessary to bear in mind, that not only is the proportion of blood-corpuscles diminished, but the quantity of albumen is reduced; also, the quantity of water is increased, and the serum is consequently of low specific gravity; and besides all this, there are present evidently toxic matters—urea and the "extractives." You will observe, then, that these conditions of the blood must affect the quantity of red corpuscles in two ways—it is calculated to hasten the decay of the corpuscles already formed, and to prevent, more or less, the development of others. Leaving out of our calculation the direct effect of the urea and "extractives" for the present, the quantity of water—the hydræmia—will of itself tend to destroy, in a longer or shorter time, the red corpuscles. Very many years ago I was led to try the effects of water upon the red corpuscles, both by mixing the blood with water out of the body, and by drinking water in large quantities, and examining the effect upon

blood drawn after these copious draughts. Many others have experimented in the same manner, and invariably with the same results. But in the latter case the water obtains a speedy exit by the kidneys, the density of the serum is restored, and the corpuscles resume their normal shape. There is no doubt whatever, that if water be added to serum so as considerably to reduce its density, an osmotic current will more or less rapidly be set up towards the interior of the globules—they will lose their flattened discoid form and become globular, and if they remain in this medium for any length of time, according to the reduction of density, they will burst and be destroyed. If even a small quantity of water be added, or the serum be rendered thin by disease, the hæmatin leaves the globules and becomes dissolved in the serum. The normal, or even increased, proportion of salts and fibrin, and the presence of some fatty matters, as cholesterin, are found to have no conservative influence if the proportion of albumen be much reduced. But in many of these diseases the albumen—the very material from which the constituents (the hæmatin and globulin) of the corpuscles are formed—is poured out of the system in vast quantities; and even in those affections in which no albumen is found in the urine, the proportion in the serum is reduced from other causes. Now, with reference to this influence of density, my own observations show that it is less in proportion as the number of corpuscles is large, and *vice versâ*. Although it has been proved that the

amount of water in the blood-cells undoubtedly stands in a definite relation to the amount of water in the serum, and that these cells are within certain limits constantly reacting on the inter-cellular fluid, yet you must not conclude that the density of the cells is rendered by osmosis the same as that of the serum in which they float. These cells have a more complex, a more elaborate organization than would be consistent with such a notion. Normally, the solid constituents of the blood-cells are almost four times as great as those of the serum. This difference in the amount of water and solid constituents present in the blood-cells, and that of the same constituents in the serum, is a very interesting fact in connection even with the amount and formation of the blood-cells themselves, and also with the other effects of these diseases. It shows that these cells are capable of exercising important changes in the *liquor sanguinis,* out of which they are in a manner formed, and from which they derive the elements which they elaborate into more complex proximate principles: they probably are instrumental to some extent, and in more ways than one, in preparing materials for the development of new corpuscles. Any condition of the serum, therefore, which tends to destroy these red corpuscles must indirectly react upon itself, by cutting off one of the sources of its own nutrition, and consequently, the nutrition of the body generally. Not only will a diminished proportion of blood-cells act injuriously to the serum, and to the system generally in this way, but, from my own investigations, it would appear

that this very diminution renders them more readily influenced by any alterations of the serum, either in its composition, or merely its density. When the red blood-corpuscles are in normal amount, and, therefore, numerous, a certain quantity of urea added to the blood scarcely produces any effect upon them; but on adding the same quantity to the same amount of blood from which a considerable number of the corpuscles had been withdrawn, a very striking effect was at once observed,—the corpuscles rapidly assumed a vermilion tint, and sunk to the bottom, presenting the appearance to the naked eye of fine vermilion; and on examining this sediment with the microscope, it was found to consist entirely of the red corpuscles reduced to about a sixth of their normal size—in fact, the effect of the urea seemed to be in exact relation to the quantity of red corpuscles. It was this great reduction in size of the corpuscles, after the addition of urea, that evidently led Hünefeld to the erroneous conclusion that this substance had the property of destroying the envelopes and setting free the nuclei. He mistook the reduced corpuscles for what he considered to be their nuclei. In the most acute forms of these diseases, those in which the dropsy is considerable, it is probable that the anæmic appearance is partly due to the dropsical condition of the subcutaneous and submucous areolar tissue, and not wholly to the absolute or relative diminution of the red corpuscles.

But not only are the corpuscles injured, if not destroyed, by the abnormal proportion of water in the

serum, but in most of the more acute affections there is a great loss of albumen, which is passing out of the system in large quantity with the urine. The nutrition, as I have before stated, of those already present in the blood must be impaired, and the development of others prevented. Lehmann and others have shown, by actual experiment, what indeed might *à priori* have been anticipated, that scanty nutrition and prolonged abstinence from all food diminished the number of blood-corpuscles. If this be the case with respect to the nutrition of the body generally, how much more must it necessarily be so when the very proximate principles from which they derive the elements of their growth are withdrawn from them!

But here it may be stated that in some of these affections in their whole course, and in others in some part of it, there is no loss of albumen with the urine; and it may be asked how can a diminished quantity of the albumen be accounted for under these circumstances? It is certainly more difficult to explain its diminution under this than under the former condition, yet not impossible. We have seen that there is an increased proportion of fibrin in nearly, if not in all, of these diseases. This is an interesting fact in connection with Simon's discovery, which I mentioned in my second Lecture, that the blood, in passing through a secreting organ, loses, in great measure, if not entirely, its fibrin, and that its diminution or disappearance, as the case may be, will be accounted for by the increase in the quantity of albumen. The researches of Bernard

and Simon have proved that there is an increase in the proportion of albumen in renal venous blood, and the following tables of Simon show that this increase bears a remarkably close relation to the disappearance of fibrin :—

	Blood from Renal Vein.	Blood from Renal Artery.
Water	778·000	790·000
Solid Matters ..	222·000	210·000
	1000·000	1000·000
Fibrin	000·000	8·200
Albumen	99·430	90·300

This, then, is the case in the normal condition. But in the diseases of which I am now treating there is invariably a diminution in the amount of urea and the extractives. These are the peculiar constituents of the urinary secretion. It seems certain that the separation of these constituents, rich in nitrogen, is in some way connected with this transformation of fibrin into albumen, and it is not unreasonable to suppose that if this separation is incomplete, the transformation will not take place at all, or in an imperfect way, and thus we shall have neither normal fibrin nor normal albumen as the effect—in fact, neither of these proximate principles in the state fit for the nutrition and development of the red corpuscles.

But there is another cause of want of nutrition of the red blood-corpuscles. In all of these affections there is a general impairment of the digestive functions. This is not to be wondered at, and might be accounted for in many ways that I have not time to allude

to here; but as there are some which have been asserted as proved by actual and oft-repeated experiments, I will venture to mention them. I have an additional motive for mentioning them, because they throw so much light on the causation of many other symptoms, and must interfere in a very marked degree with not only the nutrition of the body generally, but with the development of the red corpuscles. In the first place, notwithstanding the imperfect way in which the food is digested in most, if not in all, of these kidney affections, and the small amount of oxygen that is introduced into the system, owing to the small proportion of red blood-corpuscles, there is no doubt that urea in considerable quantities continues to be formed. It is not, moreover, eliminated by the kidneys; it remains in part in the blood, and in part it escapes from the system by other organs, but especially with the gastric and intestinal secretions. This has been proved so often, and is so universally known, that I need not mention any facts in support of it. A fact, however, noticed by Bernard, after the removal of the kidneys, is so interesting, in connection with our subject, that I cannot resist mentioning it to you. Bernard found that a dog, which had a fistulous opening in the stomach, passed daily with his urine about 93 grains of urea and uric acid, and yet, during the next twenty-four hours after the removal of the kidneys, the blood drawn from the animal exhibited only a mere trace of these constituents. Whence is the urea eliminated during this time after the operation? It is in the

intestines, and particularly in the stomach with the gastric juice, as the fistula in the stomach enabled M. Bernard to demonstrate. Before the operation, there was no urea in what issued from the opening, and immediately after it was detected in considerable quantity. After remaining some time in the intestine, the urea changed into ammoniacal salts, and, what is strange, the gastric juice was secreted continuously, and not, as in the normal condition, only after a meal. When, also, substances generally eliminated by the kidneys were injected by M. Bernard into the blood, they were found in the stomach. This vicarious secretion of urea is calculated to, and no doubt does, produce some alteration of the anatomical structures normally instrumental in the secretion of the gastric juice. Structures destined and expressly adapted for the separation of one fluid cannot long continue to separate another fluid, especially one like the urine, without undergoing a change. That this change is considerable we have indubitable proof; for, although the gastric mucous membrane will at first separate in great quantities the most important constituents of the urine, yet sooner or later it becomes disqualified for this office, and not only this, but probably also for the separation of its normal secretion.

Now, independently of the direct injurious effects of these urinary constituents upon the gastro-intestinal mucous membrane, they diminish the power of the gastric juice in another way. It is a well-known fact, that anything which neutralizes the acidity of the

gastric juice, or which renders it alkaline, destroys its solvent property. According to Bidder and Schmidt, and others, the digestive properties of the gastric juice are weakened if it be mixed with any considerable quantity of saliva, on account, as they think, of the free acid being neutralized by the alkali of the saliva. These authors also found that the addition of bile to gastric juice entirely suspended its digestive property, although the mixture still exhibited a decidedly acid reaction. Without forming any positive opinion as to the effect of urea or the salts of ammonia, resulting from its metamorphosis, on the tissues of the stomach and intestines, we may yet incline very strongly to the conclusion—indeed, it is very difficult to avoid it—that the admixture of these matters with the gastric juice is prejudicial to its digestive power. Bernard, and Bidder and Schmidt, found this to be the case. They observed that gastric juice secreted with urea sooner or later—generally in a few days—became alkaline, and that in this state it is assuredly unfit for that property which normally it is supposed to possess in an eminent degree, and that is, to convert the albuminous matters into assimilable forms. The admixture with urea and with salts of ammonia was found to diminish this property even before the gastric juice became alkaline. Lehmann also supports the opinion of Bidder and Schmidt as to the injurious effects of neutralizing the free acid of the gastric juice; for he found that its digesting power was much impeded by the addition of alkaline salts, or by saturating

the fluid with peptones or other organic substances, either *nitrogenous* or non-nitrogenous.

From all this it will not be considered unreasonable to suppose that the secretion of urea and the ammoniacal salts is not only hurtful to digestion, from its directly irritating the coats of the stomach, but also by its impairing the digestive power of the gastric juice, and so preventing the formation of normal chyme and chyle for the supply of fresh materials for the globules. It is pretty certain also that the saliva, the pancreatic juice, the intestinal juice, and even the bile itself, are deprived to some extent of their digestive properties by admixture with the urea or the salts of ammonia. That these matters are mixed with the intestinal juice Bernard has shown; and as this juice, when under normal conditions, has been found to have the property of dissolving and rendering fit for absorption not only starch, but flesh and other protein bodies, anything which affects its composition, such as admixture with urea and ammoniacal salts, is very likely to impair its digestive power. That the saliva is also impregnated with these constituents of the urine must be evident to every one who has watched persons labouring under these diseases. Patients constantly complain of a urinous taste in the mouth, and you must have often detected a strong urinous odour in the breath. In proof of this, Lehmann has found that "many mineral organic substances which are thrown off by the urine, either unchanged or little modified, are far more rapidly eliminated by the salivary glands,

—often, indeed, before they could be separated by the kidneys from the mass of blood." We may very readily convince ourselves of this fact by taking five grains of iodide of potassium in pills, when we shall find that it can be much sooner detected in the saliva than in the urine. The same occurs when it is applied endermically.

Now, it has been shown that what affects the nutrition of the body will affect also that of the red corpuscles. The small quantities of chyle formed by this imperfect digestion cannot contain the globules fit for conversion into white and ultimately red corpuscles. But even if the chyle globules were in sufficient quantity, there is another circumstance which is calculated to impede if not to arrest their development—the want of oxygen for the formation of the proximate principles out of which the conversion is to be effected. When once there is, from any cause, a great diminution in the proportion of red corpuscles, and in the amount of hæmatin, and the conditions upon which this diminution depends are persistent, the amount of oxygen absorbed by the blood will be proportionately reduced; the agents by which the oxygen is absorbed are no longer in sufficient number to furnish a proper supply. Bernard and others have shown, by the most convincing experiments — indeed, it is almost universally assented to by physiologists now-a-days—that the red corpuscles are the agents in absorbing gases, especially oxygen. An immense difference in absorbing power is found to exist between pure

serum and blood not deprived of its corpuscles. Serum with the corpuscles has been found to absorb 25 parts in 100, while serum alone, not more than one-half or one-third of that amount. Some interesting experiments by Bernard have shown that in these diseases there is another cause of diminished supply of oxygen. In glands in a state of functional activity the oxygen of the arterial blood does not disappear. —(Liquides de l'Organisme, p. 149, *et seq.*)

I have now shown, but imperfectly, I fear, the several ways in which the diminution in the proportion of red corpuscles may be accounted for, independently of any direct influence which the urea itself may exert. What that is I hope shortly to be in a position to assert upon what may be considered sufficient proof. I have, moreover, incidentally indicated to some extent the manner in which the general nutrition of the body suffers in these diseases. But the effects of this destruction of the corpuscles in the chronic forms of these diseases are not by any means comprised in the reacting influence which it exerts upon the corpuscles themselves, especially when considered with the other conditions of the blood as we have found them. This paucity of red corpuscles, when accompanied by the other conditions, exerts most interesting and important influences upon the great processes of digestion, nutrition, respiration, circulation, and innervation. I have not time to go so fully into this explanation as I could wish, and as the present state of our knowledge would justify. I will

merely passingly indicate the manner in which these conditions of the blood may act, more especially the diminution of the red corpuscles when persistent, when in a manner irremediable, as they are for the most part in many of the chronic forms of Bright's Disease, leaving you to fill up the details at your leisure from the abundant sources of information now open to us. The effects upon the digestive process, which I have described, together with the small amount of blood-corpuscles, not only interrupt in some measure the supply of the protein elements of nutrition to the blood, but even the small quantity that finds its way there is prevented by the want of oxygen from being assimilated to the several tissues. The general nutrition of the body suffers. But not only are but little fresh nutrient matters brought to the tissues in a state fit for assimilation; the effete matters, especially the fats and several hydro-carbons, are not oxidized and otherwise converted into forms by which they can either be made useful to the economy, or eliminated from it. What, it may be asked, becomes of the effete protein matters? It requires a considerable amount of oxygen to convert them into the nitrogenous excreta, more especially urea. This, in one respect, may help to explain, to some extent, the deficiency of urea in the urine in some cases, and the almost inappreciable diminution in the amount of uric acid. To convert an atom of protein into $1\frac{1}{2}$ atoms of uric acid, 33 of carbonic acid, and 30 of water, requires 91 atoms of oxygen; and to convert one atom of uric acid into one

of urea, requires 12 atoms of oxygen. The subjoined table shows this clearly:—

	C.	N.	H.	O.			C.	N.	H.	O.
Urea ..	2 +	2 +	4 +	2	= 10	2 atoms ..	4 +	4 +	8 +	4
Uric Acid ..	10 +	4 +	4 +	6	= 24	1 atom ..	10 +	4 +	4 +	6
Difference	8 +	2 +	0 +	4		Difference	6 +	0 +	4 +	2
1 Atom of Protein =	48 +	6 +	36 +	14	=	$1\frac{1}{2}$ Uric Acid ..	15 +	6 +	6 +	9
91 Oxygen ..	0 +	0 +	0 +	91		33 Carbonic Acid	33 +	0 +	0 +	66
						30 Water ..	0 +	0 +	30 +	30
	48 +	6 +	36 +	105			48 +	6 +	36 +	105

The blood is charged with other impurities than those resulting from the fault in the kidney. It abounds in fatty matters, especially cholesterin, which become deposited in several tissues, taking the place of their own proper elements of nutrition, and interfering with their function. We find this in the heart and arteries, and even in the capillaries. These important organs are cut off in a measure from the proper elements of repair at the very time that they are called upon, the heart for increased impulsive force to overcome the impediments to the circulation, which I endeavoured to point out in my last Lecture, and the arteries to sustain the increased constant pressure so rendered necessary. The heart is pretty much in the same condition as it is in extensive emphysema of the lungs. Instead of the blood returning to it being poor in oxygen, and imperfectly free from carbonic acid from obliteration of more or fewer of the vessels of the lungs, and from the large amount of residual impure air locked up in these organs as in emphysema, it is so in these cases from the small proportion of red corpuscles, and the general

state of congestion of the parenchyma, and from serous effusions into the minute respiratory passages and air-cells. I do not mean to imply that the lungs are, in many of the chronic forms of these affections, constantly in the state of actual œdema (except in far advanced and more acute cases), but that the lung-tissue is nearly always in a state of sanguineous engorgement, and the minute air-cells, and smallest respiratory passages, in at least the lower lobes, more or less completely filled with thin muco-serous fluid. The red corpuscles still circulating through the lungs take but little of the oxygen of the air with which they come in contact, and part with but little of the carbonic acid with which they may be charged; while in some portions of the lungs the air is prevented gaining access to the blood in the capillaries, such as it is, by the copious muco-serous fluid in the smaller bronchial ramifications and the air-cells. The blood then, returning to the heart, there to be propelled into the system at large, is ill fitted to nourish the heart's substance, to effect those changes in the chyle received from the thoracic duct, which are necessary for its proper assimilation, or so to oxidize the effete carbonaceous and nitrogenous compounds as to metamorphose them into substances fit for elimination by the various excreting organs. When we consider that the albumen is no longer present in anything approaching to the normal quantity—that what remains in the blood is poor in quality—that even this is being lost in varying but considerable quantities day by day, and month by

month—and that fresh supplies are deficient or imperfectly prepared, we need be at no loss to account for the degeneration which we observe in the heart, the arteries, and capillaries, and the disordered function which necessarily ensues. In considering the several phenomena which mark the progress of these diseases, we should never lose sight of the immense importance of albumen in the living body. It is assuredly, and is universally regarded as, one of the most important substances in the whole animal body. "It is met with," says Lehmann, "in the largest quantity in the blood, and in all those animal juices which contribute directly towards the nutrition of the organs; and a more careful examination of many of the animal tissues shows that albumen requires only some very slight modifications to become consolidated under different forms; as, for instance, when it contributes towards the formation of the solid contractile parts, under the form of syntonine (muscle fibrin), by which alone both the voluntary and involuntary movements of the animal body are effected. We find it both in a dissolved and undissolved form in the most delicate organic combinations; as, for instance, in the contents of the nerve-tubes," etc. Such is the description, in part, of one of the first physiological chemists of the day as to the extensive distribution and most important end of this proximate principle in the animal economy. But in order to convert this principle into organized living tissues, there is one important condition, —it is, that the different phases under which nitrogen-

ous molecules appear in the animal organism must be essentially dependent on the inspired oxygen, and that the latter, under the most various circumstances, gives origin to the numerous metamorphoses which the molecules of albumen undergo before their final change into urea and similar substances. This oxygen, then, we have found to be deficient, for the reasons I have already assigned; and this important principle—the albumen—also deficient; and the blood is highly charged with carbonaceous and fatty matters. The heart, struggling to propel forward the blood with which it is embarrassed, assimilates to itself probably a considerable share of the small supply of protein matters, such as they are, for its nutrition. It certainly enlarges, but it is scarcely strengthened—in fact, at the termination of these chronic maladies, it beats as if it were hampered, not only by the impediments offered to the transmission of the blood through the systemic vessels, but also by its own weight, its own unwieldy size. If the increase were of healthy muscular tissue, as it sometimes may be up to a certain stage of some of these diseases, it would be adequate to its end; but in the majority of cases its tissue is degraded, as we almost invariably find it in the dead-house, and so also is that of the arteries, and even of the capillaries. Atheroma is deposited in considerable quantities beneath the lining membrane, and probably in the interstices of the other anatomical elements, if not taking the place, to some extent, of those elements altogether, and so diminishing the elastic property of

the larger arteries, and the muscular contractile property of the smaller vessels, both being so valuable in promoting the circulation. Independently of the causes of retarded circulation, and consequent congestion mentioned in my last Lecture, the heart, supplied as it is with blood little better for the use of the system than venous blood, its action becomes irregular, fitful, convulsive ; its proper rhythmical movement is destroyed. That venous blood, or blood the corpuscles of which are not duly charged with oxygen, is capable of producing convulsive contraction of the muscles, the experiments of Dr. Brown-Séquard satisfactorily show. It would not be difficult to explain very satisfactorily how the nervous system also must necessarily be affected under the conditions of the blood as we find them in these diseases in their several stages. I can only give a mere outline, and leave you to fill up the details. These conditions of the blood must interfere with the nervous substance in many ways. In the first place, there is every reason to believe that the urea and other constituents of the urine retained in the blood exert a directly poisonous influence upon the nervous structure, and is itself quite sufficient to give rise to most of the symptoms referrible to this system which we observe in this disease. Secondly, the general state of innutrition from the causes which I have already alluded to, the non-removal of the effete matters resulting from the waste which is constantly going on, and the presence of highly-carbonized blood, must evidently tend to impair the nervous function. Thirdly, the general

state of congestion leading to undue pressure, as well from this congestion as from perhaps some little œdema. It is well known that some degree of pressure is necessary for the maintenance of the integrity of the nervous function,—but it is equally certain that any pressure beyond a certain amount will impair the function, or even destroy it altogether. These causes being in operation, must, I repeat, necessarily impair or destroy, as the case may be, the nervous force, whether it be directed to intellectual manifestations, sensual perceptions, voluntary and automatic movements, or to the influence which it exerts over nutrition, secretion, and excretion. The subjective sensual impressions, as noise in the ears, flashes of light, muscæ volitantes, formication in the skin, numbness of the surface, the intellectual dulness, the stupor, the vertigo, even the convulsive movements of the voluntary muscles—the epileptiform convulsions—all of these symptoms are just what we might expect, and therefore easy to be explained.

In my next Lecture I propose to enter upon the causes of these diseases.

LECTURE V.

GENERAL REMARKS ON THE CAUSATION OF THESE DISEASES OF THE KIDNEY.

GENTLEMEN,—Beforc we enter upon the consideration of the various causes of these diseases, and their several modes of action, there are some *generalities* connected with causation that require to be discussed. These general remarks will not be, I hope, without their use in preparing the ground for what I shall have to say by-and-by, and, if borne in mind, and acted upon in case-taking, and other clinical investigations, may be the means of giving us, in a few years, a valuable body of evidence on this interesting and important class of diseases.

In speaking of the causes, I shall use the words predisposing and exciting as little as possible. Strictly speaking, there are vcry few predisposing causes of these affcctions. I can only admit, undcr this designation, those statcs which are not due to the exciting or engendering causcs. Apart from any effect of an exciting causc, slow in its action it may bc, and long in its duration, but still an exciting causc, a true predisposition of the body or of the organ to disease can only be due to agc, sex, climate, constitution of body, occupation, and habits of life. Even the acquired

habit of body, except it be from disease of the heart, or from emphysema, or some other affection, which leads to congestion of the kidney, is not a strictly predisposing cause, since it is produced by more or fewer of the engendering causes, and the kidneys suffer *pari passu* with the body generally. And with respect to occupation, it only predisposes to one or other of these diseases from some connection with, or more than usual liability to, exposure to the exciting causes. Habits of life are still more doubtful, because they are inseparably connected with the exciting causes. A person, for example, habitually intemperate, and probably exposed frequently to cold and moisture, and other causes, is subjected to one prolonged influence of cold, receives a violent chill, and soon after becomes dropsical. The last exposure is, commonly speaking, the exciting cause; the previous intemperance and exposures to cold, the predisposing causes. But, in truth, the last is no more the exciting cause than are the others; the only difference is, that one is more rapid in its *apparent* effects. It, however, would not probably have been potential in producing the dropsy if a morbid change had not been gradually, although insidiously, produced by the slow but sure effects of the others.

Age.—This is of some importance in many ways. It assists us in making our prognosis, and to some extent our diagnosis also. It tells us, almost from the first, the form of disease in any case. In *old age*, we should expect to find that the kidney tissues have undergone

some degradation, together with those of the body generally. We shall be prepared to find (in hospital patients certainly) changes in this and other organs due to the influence of the *exciting* causes, especially intemperance, gout, and diseases of the heart. In *middle age*, those forms of diseased kidney will be the most frequent, the foundation of which has been laid by an attack of dropsy at an early period of life, after scarlatina, or which have been brought on from intemperance and exposure to cold, &c., or have been the result of some local mechanical injury. In *youth* and *childhood* we shall nearly always observe those forms usually resulting from or following scarlatina.

Sex.—I am not aware that sex, or rather the organization peculiar to the sexes respectively, has any influence in predisposing to the disease. Of course, the different modes of life, the different occupations and consequent difference in the amount and frequency of exposure to the exciting causes (intemperance and so on), may tend to render men more liable to these affections than women. But, apart from these circumstances, the peculiar nature of the woman, her more impressible nervous system, her more feeble and more lax organization, and the much greater influence of her generative system—all these are calculated to render females more predisposed to the influence of the exciting causes than males, the number and intensity of these causes being the same. In hospital practice it is almost impossible to arrive at any correct

results with regard to this influence of organization in the two sexes, because most of the females admitted are exposed to the same exciting causes, and to as great an extent, as the males.

After scarlatina, and therefore generally in young subjects, there are, speaking roughly, as many females as males.

Climate has an undoubted influence. All writers agree that a cold and humid, and above all a variable climate, is a very powerful predisposing cause. Yet these diseases are not unfrequent among the natives of a tropical climate.

In seeking for the probable causation of any of these kidney affections, you ought not to expect to discover it in one solitary agent. It is assuredly a very inadequate description of the process to say that (what it is convenient to call) a poison enters the blood from without, or is generated within, the body, and in passing through the kidneys exerts its poisonous or damaging influence upon the epithelial cells, which, in eliminating the offending agent, become vanquished, die, and are cast off like any other dead matter. The process is not, I take it, so simple as this description would lead you to suppose. I shall, as I proceed, place before you the main points to which you should direct your attention for the purpose of discovering the manner in which the several assigned causes probably act. The various tissues and fluids of the body being healthy, a poison, whether introduced from without or

generated within, would have but a small chance of producing kidney disease, simply as a poison. Every one of you, probably, has been exposed to and inspired the exhalations of a person affected with scarlet fever or any other fever, or the emanations from the body of a person dead of pyæmia, and yet no sensible morbid effect has been produced. These emanations must have entered the blood: they are given off by the several emunctories, for persons who have been exposed to them perceive the odour of them in their breath, in their perspiration, in the fæces and intestinal gas. But if one so exposed be "out of health," or have been previously exposed to any cause of weakness, or have an inherent weakness or vice of constitution, he becomes liable to attack. The remarkable fact mentioned by Mr. Teale, of Leeds, in his excellent treatise on Hernia, shows this very strikingly. At a dissection of the body of a patient upon whom Mr. Teale had operated for strangulated hernia, and who died from diffused peritonitis, several surgeons happened to be present; "of these, two attended one case of midwifery each during the following night, and a third three cases. The two patients attended by the first two surgeons died of puerperal fever. Two of those attended by the third surgeon also died, and his third patient escaped death from this formidable malady with the greatest difficulty, after having been in extreme danger several days." On the surgeons the pernicious emanations from the morbid secretions produced no appreciable effects, although the "poison" had been in their blood

several hours; but on the unfortunate lying-in women, who may have inhaled the poison from their breath, or imbibed it from their skin, and in whom the blood probably was in a state of active molecular change, the influence was deadly.

You will perceive that the states of the kidney, as we find them in Bright's Disease, are not the original disease, when they result from at least many of the assigned causes; nor are the secreting cells of the tubules the first anatomical elements to suffer from them. Their destruction and desquamation may lead to more or less embarrassment of the function of the kidney, but the essence of the disease is altogether different. In the majority of cases, various tissues, and a most complex organized fluid, have been affected before, or, at least, simultaneously with, those of the kidney; and even when the disease is caused by some substance entirely local in its origin and application, which irritates the organ, there is a morbid process going on before the cells are affected. No epithelial cell has ever been destroyed by any poison which acts upon the system like those animal poisons which have a tendency to produce kidney disease. Every physiologist knows that these cells may be bathed in the most active poisons, which destroy the muscular contractility, and exert the most powerful effect upon the nervous system, and yet no appreciable effect be produced in them. Take a portion of the bar of a gill of the oyster, place it in serum or a small quantity of its own juice, the cilia will be seen in active motion; add

hydrocyanic acid, opium, strychnine, belladonna—all most active poisons,—or even pass powerful electrical currents through the fluid, and yet no diminution of the active movements of the cilia takes place, as long as no influence is brought to bear calculated mechanically to injure the integrity of the cell, or to alter its osmotic conditions.* This last may, in these kidney diseases, form at times one of the links in the chain of morbid action going on, from the difference in density between the transuded or exuded matters, and the normal fluid brought to the kidney for secretion.

In my endeavour to explain the mode in which the several causes act in the production of these kidney diseases, I shall have great difficulties to contend with. The evidence, derived from experiments and observations, as to the effects of different substances upon the human body, is conflicting. There is often some truth in conflicting and opposite statements, because they are the results of experiments and observations made upon different animals, or even the same animal, but under very different circumstances and conditions. I do not complain of experimental and chemical physiologists for this. They have used the most praiseworthy precautions to avoid these sources of error; yet such are the inscrutable workings of Nature, as they occur in the living body, and so complex and so inter-dependent upon each other are many of the processes, that it is impossible to avoid them altogether.

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* Todd and Bowman's "Physiological Anatomy."

In speaking of the causes of disease, therefore, every allowance must be made for this difficulty, and the constitution and other circumstances of the individual must be taken into consideration. In the physical sciences we observe a constant relation between causes and effects. In medical science this constant relation does not exist, and we cannot always draw a positive conclusion of the existence of a cause and a determinate effect,—because the human body, taking an active part or share in the production of the phenomenon, may offer a greater or less resistance to the influence of the morbific impression in such a way as to hinder or prevent the modifications or changes that it ordinarily has a tendency to produce. Between the impression of physical agents so easy of detection, as cold, heat, and dampness, for example, and the disease which may be the consequence of them, there is an intermediate state, influence, or condition,—there is (I will not use such a vague expression as the "vital force"), there is the living body, with its impressibility, its power of resistance and peculiar reaction intermediate and all-powerful, which adds a third term to the philosophical relation of cause and effect, modifies that relation, and any phenomenon, the existence of which is manifest, is rendered by its uncertainty doubtful and open to dispute. In the practice of our common profession you must often have seen (I have already given you a striking example of it) that the same causes do not constantly produce the same, or even similar, results, in consequence of the influence of this third,

this intermediate, agent—the living body, the reaction of which from any given impression is not always the same, and cannot with any certainty be predicated. Hence it is impossible absolutely and mathematically to establish the presence of a morbific cause even the most indisputable ; and this is, I believe, the true explanation of so many different, even opposite, opinions held by different medical men upon the effects of different conditions. On account, then, of this inherent difficulty with respect to causation in general, I must ask your indulgence for the views which I am going to enunciate, as well as for those which I have already ventured to express. In attempting to explain the manner in which certain substances, or certain conditions, act upon the system generally, and the kidneys particularly, in these diseases, I do not wish my explanations (not only upon this, but upon what has already been discussed) to be regarded as established truths ; I only throw them out as suggestions having some character of probability, and as indicating the direction in which these subjects should be henceforth investigated. You must take them *quantum valeant.*

In a small organ like the kidney, with its anatomical elements so intimately, in fact inseparably, connected with each other, it is impossible that any one histological element, or set of elements, can be involved in disease from any cause without the others more or less participating in the morbid action. This has given a general and common resemblance between the

different affections, and has led authors frequently to overlook the distinctions between them. A cause, therefore, in operation for any length of time, so as to affect one anatomical element of the kidney, must of necessity in some measure affect the others also. But in carefully studying the effects of the different causes, and the affections which have followed, I have satisfied myself that different agents affect the several structures variously. Some of them exert their influence more particularly upon one structure, and others upon other structures, while all are more or less involved. This has evidently led some authors (and not altogether without reason) to the conclusion that these diseases are nothing more than different modifications and stages of one disease. But as I proceed, I think I shall have no difficulty in showing you that although they have some general characters in common, by which it is easy to see that a patient is suffering from one or other of them, yet that they severally have a well-marked group of symptoms, a definite history, and a more or less special cause.

In considering the causation of these forms of kidney disease there are four points, at least, to which we ought to direct our attention, with the view of discovering the modes in which the different causes respectively act in producing the disease. First, with reference to their effect, directly or indirectly, upon the blood, and through it upon the organ; secondly, and in like manner, upon the nervous system; thirdly, upon the tissues of the body or constitution generally;

and lastly, upon those of the organ immediately concerned.

From what I have before stated, especially in my third Lecture, you will have seen that the condition of the blood, as influenced by morbific agents, is of the first importance. Most of the causes of these diseases evidently lead to alterations of this fluid, and these may be regarded as the first term in the process. In many cases, however, in order to render them efficient causes, one or more of the other conditions must also be present.

The blood may be said, in a manner, to come in contact with every living molecule in the body, and is the sole medium by which the effete matters resulting from the waste of these molecules are carried to the different organs for elimination in one form or another. It is in constant relation, moreover, with the atmosphere in which we live, and is the only medium by which the oxygen and other materials for the repair and renovation of the tissues can be carried to them. The agency of the blood has been well expressed by Bernard:* "It is the real medium into which all the tissues cast off their products of decomposition, and in which they find, for the accomplishment of their functions, invariable conditions of temperature, moisture, and oxygenation, together with the nitrogenous materials, hydro-carbons, and salines, without which the organs

* "Leçons sur les Propriétés Physiologiques des Liquides de l'Organisme."

cannot be nourished. At all times, in this nutrition of the organs, it is necessary to bear in mind that the tissues are active, and work upon the blood so as to appropriate to themselves, according to their nature, the different materials of which they are constituted." It may also, in one sense, be said to be in close relation with the objects of our perceptions and sensations, and a painful impression is a very probable cause at times of an injurious change in the composition or constitution of the blood. The altered character of some secretions from a powerful emotion or painful sensation is probably owing to some change of this kind.

Bearing this in mind, we shall be prepared to expect that it will be the seat of deleterious substances, which have been generated within the body through (among other causes) faulty and defective secretion, excretion, and destructive assimilation, and also of matters, more or less hurtful in their nature, derived from without, and introduced into it with the air we breath, the food we take, and even with the things we touch. Nothing has been more clearly established, both by experiment and observation, than that the kidneys are the principal depurating organs for at least one class of substances; and that, whatever substances of a deleterious or poisonous nature may be in the system, it is through these organs that they make their exit. A large number of substances, when introduced directly into the blood-vessels by injection, or taken into the stomach, are discharged by the kidneys unchanged, and cause an increase or a decrease of the secretion, according as

they quicken or delay the circulation through the vessels. Many of these substances, there is no doubt, when taken into the stomach, or inspired with the air, or absorbed by the skin, or generated within the body from some catalytic action of a body in active molecular change, in passing through the kidneys, interrupt the circulation through their blood-vessels, and lead to transudation or exudation of different matters, or so change the condition of the sub-epithelial tissue, that either directly or through the sympathetic and other nerves, its formative power of generating fresh epithelial cells is impaired, if not destroyed, while the decay of those already formed is hastened.

We have seen that any cause in operation which retards the circulation in an organ, leads to increased arterial tension or pressure, and favours the escape of serum with more or less of albumen, and other matters, according to the extent of the retardation. Majendie detected albumen, and even blood, in the urine, after injecting a certain quantity of water into the blood-vessels. Kierulf also observed this. He placed a tube in the ureter to receive the urine before, during, and after the injection of water into the veins. He then injected 500 grammes (about sixteen ounces) of distilled water into the jugular vein of a large animal. The urine, which ran normally for some time, became albuminous, afterwards the albumen increased, at the same time the urine became more and more red, and from ten to twelve hours elapsed before the urine returned to its natural state. During the experiment the

animal was bled, in order that the composition of the blood might be compared with the change that might ensue in the composition of the urine. The quantity of urine obtained in one minute before the operation was 0 gr. 108; after the injection it was raised to 0 gr. 227. The residue obtained by evaporation of the normal urine differed notably from that from the bloody urine received after the injection. This last gave a less abundant residue. Thus in 100 parts of urine, the dry residue was found to be, in the normal urine eleven parts, and in the urine after the injection 3-8 parts. This large diminution of solid residue, after the injection of water, bore principally, if not entirely, upon the salts—a very interesting fact in connexion with the composition of the blood and urine in these diseases. The injection led to the appearance of albumen and globules in the urine at the same time that the salts disappeared. The opposite of this occurred in the blood in which the proportion of salts had increased.

Bernard has stated that even if the blood be surcharged with albumen that has been taken as food, it will appear in the urine. He found albumen in the urine after the ingestion of six raw eggs, while fasting. But it was only temporary. In two or three hours it disappeared. Poiseuille found by injecting a solution of yellow prussiate of potash, mixed respectively with nitrate of potash and acetate of ammonia, that the circulation was more rapid, and the amount of urine was increased, while with the solution of the yellow prussiate mixed with alcohol, the circulation was much

retarded, and there was a tendency to transudation. These facts, duly considered, give a key to the action of some of the causes of these affections.

The second point with reference to causation in these diseases is the *Nervous System.* That the nervous system exerts a great influence upon the nutrition and secretion of the kidneys there is no doubt. So long as it remains unaffected in its function by any cause of disturbance, that influence is for good, and is indispensable. But if its function be disturbed, the effect upon the kidney must be prejudicial, and it may then become a direct agent in the production of disease. We see instances of this in many diseases, and also in many moods of the mind, and after many injuries. In the agitated and deranged state of the whole nervous system, as in hysteria, or after strong mental shocks, or during anxiety from any cause, the proper secretion (as a secretion) of the kidney is often arrested. The kidneys, for a time, do little more than filter the water from the blood; their special agents of secretion are so changed, that they are no longer fitted to separate the peculiar constituents of the urine. A calculus in the bladder, or in the pelvis of the kidney, or any other source of irritation near the excretory duct, will produce pretty much the same result, through probably a reflex action.

It has been rendered tolerably clear by experiments and observations, that the normal urinary secretion depends upon three causes; two, to a certain extent, mechanical, and one, nervous, neither of which is an

efficient cause of true secretion without the concerted action of the others. Ludwig and Virchow have shown that a *certain amount of arterial pressure* is indispensably necessary, and that up to a certain degree, the amount of urine will be in proportion to that of the pressure. Poiseuille has shown that a *certain definite composition of the blood* is necessary. I need not repeat the numerous and convincing experiments by which he has rendered this evident. Suffice it to say that some substances, when added to serum, will promote the circulation, and therefore favour secretion, while the presence of other matters—as alcohol—will impede the circulation, and diminish, if not prevent, secretion. Lastly Bernard has proved (if, indeed, any such proof were wanted) that the influence of the nervous system is essential, and that without this aid the other two are powerless; in fact, that the combined action of the three is necessary. This experimentalist thinks (but without actual proof) that the nerves exert their influence upon the capillary circulation particularly, and that the mechanical causes, pressure and constitution of the blood, act more particularly upon the more direct circulation. There is no reason, however, why they should not all act in concert upon the whole of the structures concerned in the important function of secretion. It assuredly would be more in accordance with the manner in which Nature plans her work. The following experiments show conclusively the influence of the nervous system on the circulation and the secretion of the kidney, and how necessary it is to bear

this in mind in considering the causes of disease in this organ :—

On cutting the left great splanchnic nerve, the renal vein diminished in calibre, and became black ; secretion was suspended. On isolating the left pneumogastric below the cardia, tying it and galvanizing its distant side, the renal vein immediately became distended and red, and the ureter also distended with urine. On ceasing the galvanization, the vein diminished in volume, and became black. On recommencing the excitation, the vein again swelled up, and became red. On opening still more freely the abdominal cavity, and examining the *right* kidney, it and its vein were tolerably red. On galvanizing the *left* pneumogastric, the right renal vein became also more red and more distended. On then cutting the right great splanchnic, the corresponding renal vein diminished in volume, and became black ; secretion was arrested. On again galvanizing the vagus, the vein resumed its redness and turgidity. Bernard has, moreover, found that *le point de départ* of the innervation of the kidney is in the medulla oblongata — somewhere probably about the floor of the fourth ventricle. In general, says he, when the instrument touched the lowest part of the floor of the fourth ventricle, polydipsia was produced ; when it touched a part situated a little higher, sugar appeared in the urine ; and a little higher still, albumen. This is an interesting fact in connection with the influence of emotion on the secretion.

Not only, then, may particular states of the nervous

system interfere with the circulation and secretion of the kidney, but they may also lead to the presence of albumen in the urine. We shall find, on discussing the causes of these affections, that some of them exert their influence either in whole or in part through this system.

The next point is the state, natural or acquired, *of the tissues of the body generally—the constitution of the individual.* "A lax habit of body;" "a relaxed state of the tissues;" "a flabby, loose, atonic condition of the solids;" "a defective, frail, and weak organization;" "a watery, transparent state of the tissues;" —all of these are familiar expressions used (and very appositely) in practice to describe conditions which are calculated to render the body unusually prone to disease from slight causes, and to make a restoration to health very difficult and protracted. These expressions are eminently suggestive, and yet, with reference to the causation of disease, the states of body, of which these are correct expressions, are not, so far as I am aware, sufficiently taken into account. These states are of great moment; for not only do they enable us, in some measure, to come to a just conclusion as to the efficiency of an assigned cause for the production of disease, but they also lead us, with some degree of probability, to a knowledge of the precise consequences of the operation of such a cause, namely, the disease itself. I have already alluded to the different degrees of resistance offered to any external or internal condition adverse in its tendency to health. An assigned

eause (more cspecially of these affeetions of the kidney), which wc should not be disposed to admit as an effieient eausc of disease in one person, would undoubtedly be so in another possessing a lax and feeble organization. Then, as to the changes likely to be produced by a given eause; it is easy to predict, in a ease in whieh albumen may be found in the urine of a person having this lax, pasty, atonie state of body, almost the preeise condition of the kidney; either, it may be, that there is searcely any perceptible deviation from what may be rcgardcd as the normal condition in a person so eonstituted, or that it is a large, white, flabby kidney, aeeording to the scverity or duration of the disease.

Also with regard to the *Prognosis,*—not only is there less rcsistance offered to any adverse influenee as a eause of disease, but there is a proportionate want of power in resisting thc ravages of the disease itsclf. It runs (speaking of these kidney diseases) a more rapid and destructive course, and terminates in death, with scareely such an amount of struetural change as would have placed the life of another person, more firmly knit, in jeopardy. We ean never form an aceurate eonelusion as to whether an abnormal ehange of strueture is sufficient to produee death, without taking into consideration the general structure, organization, and constitution of the individual. In such a disease as emphysema, for example, in explaining the meehanism of this state of the lung, how little attention is apparently paid to this, one of the most important elements in the problem. Some people are born with an organ-

ization favourable for emphysema pulmonum. The several lung-structures yield before any amount of pressure, from whatever eause arising: the vessels are obliterated, the tissues waste, with no greater amount of pressure than is borne by a very large majority of mankind without any injury aceruing whatever. So it is with the kidney; its funetion may be impaired, perhaps arrested, by a eondition of the blood or of the nervous system, or from some loeal irritation, whieh in a person more strongly organized would produee no, or but little, appreciable effeet.

In such persons, again, not only is the organ itself unable to offer resistance to any of the known eauses of kidney disease, but the blood, and the nervous system also, share this inherent weakness. Both offer very little vital resistance to the influenee of morbific agents. The blood is little better than a lifeless fluid, exposed to all the influenees of deeay. The best, beeause the most palpable, illustrations of this are the fevers. From a easual and very short exposure to the exhalations of searlatina, a small quantity, it may be, of the poison may reaeh the blood in the lungs, infeets it, and immediately, and with frightful rapidity, catalytie aetion is set up—a little leaven soon leavens the whole mass,—and the person dies a few hours after the first manifestation of the disease. This, I believe, is frequently the ease in these kidney diseases. Through some cause or other, a person having this constitution may have a mild attack of the disease; you will often be able to predict that such a person will almost cer-

tainly have dropsy, even without any sensible exposure to cold. In fact, the tissues of such persons are always in a semi-dropsical state.* The same is the case with another frequent cause—alcohol. This may have been taken in comparatively small quantities, to such an extent so slight as scarcely to affect one person, although habitually indulged in for a long series of years, and yet, in a person with the constitution such as we have alluded to, the blood will be so altered, the nervous system so deadened, that the one is suitable neither for the nutrition of the organ nor for its secretion, and the other also is equally incapable of exerting its share in these processes.

The last point *is the state of the organs*, what may be called the *anatomical condition of the organ.* This is closely connected with the preceding condition, but yet it will be convenient to make a few remarks on it separately. It cannot surprise you that, the function of the kidney depending upon both mechanical and nervous causes, some local conditions should interfere with its circulation and secretion. Experiments have

* I am aware that there is some little apparent contradiction here. It may be asked, if what I have said with regard to constitutional states be true, how can such persons have scarlet fever in a mild form? But every Practitioner knows, that through some unusually healthy conditions of the atmosphere, or through the less virulent character of the scarlatinal poison, some epidemics of this disease are much milder than others. That some animal poisons are less active at some seasons than at others, there is no doubt. This may be even said of the poison of the viper.

shown that mere irritation of the tissues of the organ will lead to the presence of albumen in the urine. In our next Lecture I shall state the individual causes. In the list will be several which operate as causes of these diseases, merely from the local irritation which they set up, and a knowledge of which, in a living body, we can only get at negatively by the absence of any general cause, and a careful examination of the urine. The albumen, from direct irritation of the tissues of the kidney, is not only in the urine, it is, as I have said before, in the tissues also. This is not like a secretion performed by the agency of the cells, but it arises from an altered state of the blood-current favourable to transudation or exudation, and what the matters transuded or exuded with the albumen may be or what may become of them after exudation, will depend on the constitution of the individual.

That mere irritation of the kidney will not only lead to the presence of albumen in the urine, but also produce a decided effect in other respects upon the secretion, the following experiment of Bernard convincingly proves. I quote it the more readily, because it shows, in a very satisfactory manner, another way than those which I mentioned in my last Lecture, by which the supply of oxygen in the blood is diminished in these diseases. It seems that the kidney, in common with all glands in a state of functional activity, exerts a peculiar action upon the blood passing through it, in addition to those which I have already pointed out, which is very interesting to us, because, as its secretion

is continuous, it must have a much more decided effect upon the system than other glands. When the secretion was going on normally, the gaseous composition of the arterial and venous blood was as follows :—

At a temperature of 10° to 12° (50° to nearly 53° Fahrenheit).

	Blood of Renal Artery.	Blood of Renal Vein.
Carbonic Acid	0·00	0·00
Oxygen (in volume)	12	10

At a temperature of 40° to 45° (104° to 113° Fahrenheit), it was—

Carbonic Acid	3·00	3·13
Oxygen	19·46	17·26

On irritating the kidney and stopping the secretion, the blood in the renal vein became black, and its gaseous composition was—

Carbonic Acid	6·40
Oxygen	6·40

LECTURE VI.

SCARLATINA AS A CAUSE OF BRIGHT'S DISEASE.

Gentlemen,—It seems to me desirable, for clinical purposes, more, I confess, than for any other practical object, that I should arrange the several agents reputed to be instrumental in the causation of these diseases under three categories.

1. Those whose action is upon the blood primarily, and upon the nervous system, and upon the tissues of the organ, secondarily.
2. Those which affect the nervous system primarily, and the blood and tissues secondarily.
3. Those which, either by direct or reflex action, affect the tissues of the organ primarily, and its own nerves secondarily.

Now, although there are probably some advantages in this arrangement, yet I do not overlook the objections to which it is open.

For example, where ought we to place alcohol and other allied fluids? I shall place it under our first class. You will see, however, by-and-by, that there are strong grounds for including it under the second. So also with scarlatina; but I have had less difficulty as to where this ought to go. I have placed it under

the first category, believing, as I do, that it is essentially a blood disease, and that its action upon the nervous system is altogether secondary. Yet some writers upon this disease think that its primary influence is altogether upon the nervous system.

The most comprehensive and, at the same time, the most practical way of including all the possible causes of these diseases, would be this:—Any substance, state, or condition, which is calculated to impair the nutrition and secretion of the organ, retard the circulation of the blood in its vessels, or irritate, directly or by reflex action, its nerves and tissues, may be regarded as exciting or engendering causes; and any condition of the body, natural or acquired, which renders it more than usually impressible to the influence of certain morbific agencies, will, of necessity, predispose to the disease, and make those substances, states, or conditions efficient causes.

Under the First Division I put scarlatina, erysipelas, measles, variola, cholera, struma, syphilis, phthisis, gout, rheumatism, &c; alcohol (and in this I include all fermented alcoholic fluids), turpentine, ether, naphtha, chloroform, &c. You will see that I have placed alcohol and other hydrocarbons last, and I have done so because I have some doubts whether they ought not to be placed under the second division.

Under the Second Division I put cold, cold and wet, and more especially sudden and great transitions of temperature; injuries or diseases of the brain and spinal cord or sympathetic system, whether from

centric or eccentric causes; anxiety of mind, mental shocks, &c.

Under the Third Division I am disposed to include all injuries and mechanical causes of irritation: as blows, the presence of calculi (microscopic or larger), cantharides, and other irritant poisons, onanism (Rayer), excessive venery (Rayer), amenorrhœa, and other uterine affections; and, lastly, diseases in other parts of the urinary apparatus, which are calculated to produce reflex irritation in the kidneys.

The first on our list is *scarlatina.* There is no doubt that scarlet fever is one of the most frequent causes of kidney diseases, attended with albuminous urine. What is its mode of action? To answer this question satisfactorily, it will be necessary to consider what takes place in the system generally, as well as in the kidneys, in this disease. It will assist us in understanding the *modus operandi* of this and the other assigned causes, especially cold and wet, and alcoholic and allied fluids, if I make a few remarks upon the physiology of the urinary secretion.

In scarlet fever, what is the condition of the body generally? That the skin and some few of the mucous membranes are not the only parts which suffer, I shall endeavour to make evident to you. The capillary blood-vessels of the skin are not the only ones that are congested by the retarding, stagnating influence of the "poison." The vessels of every structure and organ of the body suffer, if not to an equal, yet to a very great extent. It is true we cannot see the precise

condition of the vessels in the internal organs as we can in the skin, and in the mucous membranes of the eyes, nose, mouth, and fauces; but we have equally certain evidence in the symptoms.

The *circulation in the brain and nervous system* is also affected. We have evidence of this in the disordered function of these important organs.

The *muscular system* is also affected. This is evident from the pain felt, in many cases, from motion and pressure, much resembling rheumatism. In fact, there are strong grounds for believing that the scarlatinal poison acts much in the same way as the true rheumatic poison, and that there is a close and intimate resemblance, in many respects, between them.

That the *serous and synovial membranes* suffer, we have evidence in the frequency of effusions in both, and in the pain and stiffness in the joints.

That the scarlatinal poison *irritates the glands*, the constant pain, swelling, and frequent suppurations in or around them attest.

There is also a remarkable tendency to *exudations* in scarlet fever, and an exudation of a very low character—not of fibrinous matters readily organizable, but of a low form of albumino-fibrinous matter, which has a great tendency rapidly to be converted into a sort of albumino-purulent state, or even into true pus. The great tendency to the formation of pus is shown by the frequent abscesses in the areolar tissue beneath the skin and some mucous membranes, and in the neighbourhood of the glands, and in the

purulent infiltrations between the muscles. There is also very often an exudate of a low form of albumino-fibrinous matter on the *free surface* of the mucous membrane of the fauces, and of a dirty-looking puriform serosity in the areolar tissue, beneath the mucous surface of the pharynx and larynx. There is in most cases of scarlet fever a deficiency of true fibrine, hypinosis, as it is termed.

In the mild forms there may be an increased *transudation* of the *liquor sanguinis*. The tumefaction that is so often observed, and the sensation felt by the patient, as if he were generally swollen, may in part be due to this transudation, as partly it is undoubtedly due to the state of congestion of the vessels generally.

With reference to this congestion, it seems to me that writers upon the exanthemata have too much relied upon simple congestion as the cause of the eruption, and have overlooked the direct influence of the "poison" upon the red blood-corpuscles. We know that several substances, some of them poisonous, give a scarlet hue or vermillion tint to the red blood-corpuscles,—urea and several other animal products, arsenious acid, the nitrate, phosphate, proto-carbonate, and sulphate of soda, and the sulphate of magnesia; but all the sulphur and hydro-carbon compounds darken them. This is certainly an interesting subject for further investigation, which might lead to more certain information as to the real nature of the scarlatinal poison. There is very strong evidence that it is volatile, and that it is a product of the animal body,

and therefore an alteration probably of some normal animal principle. It may be closely allied to some of the odorous excreta of the body; for no one who has had under his charge several patients in one ward labouring under these exanthemata, can have failed to detect a peculiar odour belonging to them. I am quite sure that I know the scarlet fever odour and the small-pox odour.

This, then, is the description of what takes place to a greater or less extent, according to the severity of the disease, in the organs and tissues of the body generally. Is it unlikely that what occurs in so many parts should take place in the kidneys also,—the very organs whose office it is, in common with the other emunctories, to eliminate the poison from the system? If we could observe what takes place internally in the tissues generally, and in the kidneys in severe cases, we should see something resembling this condition. That the capillary vessels are congested and distended by the scarlatinal poison, there is no doubt, whether that poison acts directly upon them or indirectly through its paralyzing influence upon the nervous system. There is also another and very important cause of congestion, probably in operation. This state of congestion, the immediate effect of the scarlatinal poison, never occurs without retardation of the blood-current. When there is a general retardation from any cause in the capillaries, there is always an effort on the part of the heart to overcome the obstruction, and this explains, in some measure, the full bounding pulse which we so commonly, almost invariably, find in the early stage of the

disease. But this does not continue long. The heart, sooner or later, becomes weakened by the direct effects of the poison upon the blood circulating through it, and the diminution of the nervous power, caused by the condition of the blood, as well as probably by the paralyzing influence of the poison upon the nervous tissue itself. From one or other, most probably from both, of these causes the heart becomes weakened, and we have now the jerking, compressible, almost continuous pulse; that is, a pulse without any distinct, appreciable interval between the beats, which every Practitioner will recall to his recollection as being present in severe cases of scarlet fever. The heart then fails, and this offers another impediment to the circulation, another cause of blood retardation in addition to the direct influence of the scarlatinal poison, the change in the blood, and the impairment of the nervous force. I need not mention to you (for I have done that in my Lectures on the Diseases of the Heart) the experiments which have been made to show that a certain force on the part of the heart is actually necessary to carry on the circulation through the veins, and that if the force be below a certain amount, first capillary, and then venous, congestion will be the result. Besides these, there is a greater or less interference with the play of chemical affinities, which in health undoubtedly promotes the circulation.

Here, then, are the four causes of blood retardation and congestion, and probably increased transudation at a comparatively early period of the disease.

Up to this point we will suppose the eruption to be general, and to be "well out," as the phrase is. But now a time has come, sooner or later, according to the severity of the disease, it may be within a few hours, as in that form appropriately designated *scarlatina maligna,*—a time has come, I repeat, when there is not merely retardation of the circulation and increased transudation, but when there is more or less extensive stagnation, and relief to the distended vessels is sought in *exudation,* and a patchwork, dappled state of the skin is presented to us; or, as in *scarlatina maligna,* this state may have been present almost from the first onset of the disease. Effusion or excessive transudation has taken place in some situations, especially in the skin, and this may be limpid serum containing an excess of water, or it may be a denser kind of serum containing a larger proportion of albumen. In the former case, the effusion will appear at a comparatively early stage of the disease, and frequently under the form of sudamina. In other situations, especially on and beneath many of the mucous surfaces, we have exudates of different kinds, depending upon the "constitution" of the epidemic, or that of the individual, or upon both combined. But these exudates are never fibrinous, or rather fibro-plastic, unless in the case of some co-existent inflammation in one of the serous membranes, as, for example, in pericarditis. There is scarcely ever that network of fibrillation which we observe in coagulated fibrine. It appears under the form of the first and second varieties of Rokitansky's

croupous exudation. It may be fibrin that has undergone some slight molecular change which has altered its physical properties, but not its chemical composition. These exudates contain, besides this altered fibrin, a great number of molecular granules and flake-like laminæ, and, in a short time, nuclei and cytoid corpuscles. In short, as I have said before, these exudates are of a low form, are not organizable, and have an unusual tendency to be metamorphosed into a more or less perfect purulent matter, in which is observed a considerable quantity of fatty matter; and sometimes this degraded metamorphosis takes place very rapidly. There is then in the severe forms of the disease a general inflammatory condition of the skin, of the mucous membranes, and of the areolar tissue, which eventually leads to more or less desquamation of the skin and of the epithelium in the two first, and the formation of abscesses, or to exudative or purulent infiltration in the last.

Can we suppose that all these morbid processes can go on so extensively in all the tissues of the body, and that the kidneys should remain free from the diseased action?

But I will remark here, that I do not think that the structures of the kidney suffer so much as many others. The kidneys, according to my experience, are not unusually prone to take on diseased action. To suppose so would be inconsistent with our daily experience; for we find these organs, even in old persons, perfectly healthy, notwithstanding that they have been con-

tinuously at work during so many years, and have been frequently exposed in the life of every individual to numerous causes of irritation and decay. But in scarlet fever they do undoubtedly participate in the several morbid actions; and we have certain evidence that the increased transudations of the milder forms of the complaint, and the exudations and general inflammatory condition of the severer forms are also present in the kidney structures.

We are now in a position to account for what we observe in the urine during life, and in the kidney itself after death.

Those who have taken the pains carefully to examine the urine day by day, have found albumen even at an early stage of the disease, but certainly almost always from the commencement of the desquamation. In severe forms the urine has not infrequently been found to be bloody,—that is, to contain red blood-corpuscles, in addition to the serum. Is it surprising that we discover albumino-fibrinous casts, epithelial casts, blood casts, and red corpuscles; and if we have these in the urine, after it has traversed the tubules, is it not probable that the tissues of the kidney are infiltrated with sanguineous effusion, and also with this low form of albumino-fibrinous material?

This morbid process going on, in what way is the function of the organ likely to be affected, and what means are there for the removal of these exuded matters? There are three:—the tubules, venous absorption, and lymphatic absorption. Let us inquire

how far these means are in a state to perform this office. The tubules are more or less obstructed with solid matters, which in some parts may impede, in others prevent, any escape in this direction. The circulation in the venous radicles is nearly arrested, and but little absorption can take place in this way. The lymphatics are pressed upon by the exuded matters themselves and by the distended blood-vessels, while the whole organ is closely invested by a capsule composed of an inelastic, or certainly a not readily-extensible, tissue. These agents of absorption are not in a condition very favourable for the adequate discharge of their office. These three agencies failing, there is no way of escape for the exuded matters that at this time probably have become mixed with a large proportion of the constituents of the urine. If any absorption by the lymphatics take place, only the more fluid portion can be taken up, and probably this is more or less mixed with the urinary constituents. The secretion also is all but arrested, and the whole mass of blood is deteriorated by the presence of the urinary excrements, ill-prepared as it was before for this additional cause of vitiation: its own previous diseased condition is now reacting upon itself. It has probably not recovered its normal condition before it is exposed to another and even more serious cause of deterioration; and this fluid, upon the purity and soundness of which depend the well-being of the whole organism, the nutrition of the tissues, the due performance of the functions of organs the most vital, is circulating

through vessels and tissues that either are, or but lately were, weakened and disabled by the primary disease. You eannot, therefore, be surprised that anasarea oeeurs in this eomplaint even from a eondition that would not produee it if the general tissues had been healthy, and had possessed more tone.

Now, suppose a person die from the disease on the fifth, sixth, or any day about this period, and supposing that the morbid proeess in the kidney be sueh as I have deseribed, what morbid appearanees would you be prepared to find? The vessels are greatly distended, there has been more or less blood-stasis in some parts, principally in the veins and in the Malpighian tufts; the kidney then will be in a state of great sanguineous eongestion or engorgement — there will be observed numerous red dots and streaks, and the general tissue, being infiltrated with a kind of sanguineous transudation, will either present a diffused redness, or this redness will be more or less intermixed with whitish or yellowish-white lines. The whitish parts will be due to exudative matter. On the surfaee there will be also a diffused redness, or here also there may be a mottled appearanee, the darker parts being due to the arborization of the minute veins. The tubules will be more or less distended with blood-easts, exudative matters, and east-off epithelium. With all this the eapsule has not yielded mueh to the internal pressure, and the kidney, although larger than normal, is not so large as at a later period after anasarea. This state of engorgement, exudation, and desquamation will, of course, vary

in proportion to the severity and duration of the disease; but subject to this it will be more or less as I have described it. You will see, then, that this state very closely resembles, is indeed identical with, the first form of Rayer, as figured in his Atlas, pl. vi., fig. 1, and pl. x., fig. 3, large diagrams of which you see before you. It is the same as the congestive stage of the large white kidney of Bright and Wilks, and an early stage of the first two of Rokitansky.

Gentlemen, I do not wish you to go away with the notion that this state, as I have described it, occurs in every case of scarlatina; but yet it is, I believe, an accurate description, modified according to the severity of the disease, and the period at which death has occurred. If the fatal event has taken place very early, there will be nothing more seen than intense congestion, with probably some extravasation; and the longer time that elapses between the commencement of the attack and the fatal issue, the greater will be the change in the structure of the kidney. If the attack of scarlatina be mild, although death does not occur, and we have no opportunity of seeing the kidney, yet we may easily imagine that the congestion will be much less considerable throughout.

There is a very general impression that dropsy is more frequent after mild attacks than after severe ones, or at least as frequent. If, therefore, the kidney undergoes such extensive changes in the severer cases, the reverse of this ought to be the case. I am, however, not quite sure that there is a greater liability to

dropsy after mild attacks, nor do I think it would be nearly so frequent after the mild attacks of the disease, if the same care and precaution were observed in what may be called the "after-treatment" of the disease. In severe cases the patients remain under strict medical treatment so long as the slightest signs of the disease or of its effects are observed. In mild cases, on the contrary, I believe that patients are very often supposed to be cured before the poison is really out of the system, and any exposure to cold, or to cold and wet, which is sufficient to produce a chill, or any debauch, or imprudence in drink or diet, will soon lead to all those states of the kidney, and of the organs and tissues of the body generally, which I have described.

I think it necessary here to warn you against the notion that there is less danger of a relapse or of dropsy after a severe attack than after a mild one. After any attack of scarlatina, however mild it may be, you may rely upon it that great damage has been sustained by the blood and tissues of the body, and your patients ought to be emphatically recommended to exercise great care and caution if they wish to avoid the risk of an attack of dropsy, or some other sequela of scarlatina. After a severe attack, however, a considerable portion of time elapses before the blood and tissues have entirely recovered their normal state. During the ten years that I was at the London Fever Hospital, I had opportunities of witnessing several relapses into the disease, in which there was a return of the eruption, of the sore throat, and of the general

inflammatory condition. I have, on several occasions, seen three relapses in the same individual, even when the first attack was one of a very severe character; and if you will carefully watch the cases in the wards, you will find that few persons, labouring under severe forms of scarlet fever, escape a partial return of the feverish symptoms, and also of the eruption.

But, to consider the subject with more especial reference to the kidney, suppose that the patient does not die at the period that I have mentioned, and that he is attacked with dropsy. If he is carried off at this time by convulsions, or any other immediate cause of death, the kidney will be in much the same state as I have already described, except that its tissues and its tubes may be infiltrated by a greater quantity of fluid; it may itself have become dropsical. If, however, he has lingered on for some months, the anasarca, although at times checked for a little, yet in the end has increased, and he then dies from coma, or convulsions, or from effusion in one or more of the great serous cavities, or from inflammation in some parenchymatous organ, or he is suffocated by the œdematous condition of the lungs,—in what state should we expect now to find the kidneys according to our view of the morbid process? In this case the hæmatin will have disappeared; some of the corpuscles, and the blood and other casts with which the tubules were clogged, will have been discharged, or the tissues will be infiltrated with serosity, and the albuminous croupy exudates may in part have escaped by those few other tubules, which have become

pervious, and in part have remained in the tubules and Malpighian capsules, together with the altered blood, and the desquamated and degenerated epithelium by which they may have become infarcted, and rendered impervious to the passage of the urine. The same inflammatory exudates still remain in the tissues, or they may have undergone a sort of gelatinous metamorphosis more or less abounding in fatty matter, and the tubes themselves in many parts may be wasted and obliterated from the pressure. The smaller arteries being in like manner pressed upon, any further supply of blood is cut off, and there is, consequently, an anæmic appearance of the tissues generally, with here and there a few congested venous radicles. All this, for the most part, has taken place in the external, secreting, or cortical portion of the organ, which has consequently increased in thickness at the expense of the internal, or medullary, or excreting portion, and the fibrous investment, having been exposed for weeks or months to constant pressure from within, has now yielded considerably, so that the size of the kidney may be even three or four times greater than in the normal state.

Here, then, we have a kidney closely resembling the second and third forms of Rayer, as figured in his sixth plate, fig. 4, a large diagram of which is also on the wall, the large white kidney of Bright and Wilks, and the third and fourth forms of Rokitansky.

That this is no imaginary description many of you have seen in the dead-house, and many may still see;

and such are the processes, as I think, by which these morbid states are produced.

But there still remains some little difficulty with regard to this part of our subject. It is perfectly legitimate to inquire how, if the kidneys are so much congested, albumen is not more frequently, indeed, almost always, found in the urine? I am, however, not quite sure, that if it were carefully looked for in a sample of urine taken from the whole quantity passed daily, some traces might not be found. But even if some be transuded, as some may be even in health, there are three ways at least by which it may be removed from the true urinary constituents before their exit from the convoluted tubules. It may be absorbed by the tubules themselves; it may also be removed by the lymphatics and the veins. The lymphatics alone, with their wonderful power of absorption, and (by means of their strong muscular walls) of circulation also, will remove large quantities of albuminous fluid in a short space of time, if these vessels be not pressed upon and disabled by more solid exudates, and by the general turgescence of the blood-vessels. The solid matters must undergo a process of liquefaction before they can be taken up, and I have no doubt but that this often takes place without our knowing the curative process that has been going on beyond our sight. Our patients may often have been near a fatal condition of things without our being aware of it, from which they have only escaped by the *vis medicatrix*, acting through the lymphatics.

But we have seen that albumen may be present in the urine from many causes, independently of disease of the kidneys. For example, (1) from direct irritation of the floor of the fourth ventricle, or of the nerves of the kidney, or of the organ itself; (2) from the ingestion of any unusual quantity of albumen; (3) from pathological conditions of the nervous system; and lastly, from the introduction of water into the blood. Now, all this seems easy of explanation upon the view which I am disposed to take of the process of the urinary secretion. You will find that it is somewhat opposed to the theory which Mr. Bowman promulgated, from a careful study of the anatomy of the kidney, as revealed by his extensive, patient, and admirably-conducted investigations, and which was almost universally accepted as true by physiologists, and has ever since been taught in the Schools. Many of those, however, who even teach this theory in their lectures, are not exactly satisfied with it, and yet are not prepared to state definitely in what they dissent from it. I must confess that I have not been able to give my faith to it for some time past. There are so many difficulties in explaining many conditions under this theory, that I have been led to conclude that, ingenious as it is, and true undoubtedly in many respects, yet that it does not comprise the whole truth. According to this theory, then, it would appear that the retardation of the circulation, and consequent increase of pressure, which the peculiar arrangement of the Malpighian vessels is so eminently calculated to pro-

duce, lead to the separation "of the fluid portion of the urine" by a process of filtration, while the solid matter, composed of various organic constituents and inorganic salts, is separated by the aid of the glandular epithelium, which lines the convoluted portion of the tubes.* The water is supposed to come from the blood in the Malpighian vessels by a process of filtration, and the organic constituents and the inorganic salts from the blood in the capillary network surrounding the convoluted tubes, by a true secretion, through the epithelium lining the tube. Now, in examining closely this theory, we must conclude that the blood, in passing through the Malpighian capillaries, where the circulation is most retarded, and where the greatest lateral pressure must necessarily be exerted upon their walls, only parts with the water; while the network of capillaries which receives the blood from the small efferent vessel, where the lateral pressure must be very much less, permits the transudation through their walls of ordinary blood plasma, together with the "organic constituents" and the "inorganic salts" of the "secretion," in order that the "true secreting elements" should separate the latter. In order to accept this as true, the capillaries into which the efferent vessel breaks up (the Malpighian capillaries) must have much thicker walls than the capillaries which surround the tubes, and which are formed by the efferent vessel.

* "Physiological Anatomy and Physiology of Man." By R. B. Todd, M.D., and Wm. Bowman.

This difference (if there be any) I have certainly never been able to discover.

But is it probable that a contrivance, so admirably adapted as is the Malpighian tuft for delaying the blood currents, should have for its sole office that of a filter, and that it should separate in part merely the menstruum which holds the more important substances in solution? I do not undervalue this function, even if it be the only function of this elaborate arrangement. There is no doubt that the mere separation of water, or, rather, that a contrivance suitable for the separation of large quantities of water under certain states, is indispensable to the economy. It is essentially necessary, in order that the blood may, within certain ranges, be preserved at a uniform density, even under circumstances calculated suddenly to increase the amount of water in it from ingestion or other causes.

Next, to supply the blood plasma for so much solid, highly animalized, and saline matters as pass off by the kidneys daily, there must be some arrangement eminently calculated to retard circulation and to favour transudation. What do we find in the anatomical arrangement as described by Mr. Bowman? A small vessel suddenly breaking up into a rounded bunch of capillaries, having "a far greater aggregate capacity than itself, and from which there is but one narrow exit,"* the efferent vessel, which also breaks up into a network of capillaries, which surrounds the convoluted

* "Philosophical Transactions," 1842.

channels or tubules. It is impossible to conceive a more admirable contrivance for retarding the blood current; and the efferent vessel being so small, and the capillaries into which it breaks up being of smaller diameter than those of the Malpighian bodies, "it follows, from the law of hydraulics, that there must be a greater pressure against the walls of the latter."* And yet, according to current notions, the capillaries of the small efferent vessel, with this small amount of pressure, are the only vessels from which the transudation of the *liquor sanguinis* takes place, not only for the nutrition and repair of the tissues, but also for the separation daily of upwards of one thousand grains of solid constituents of the urine. Moreover, is it probable that the same blood plasma should at the same time, and in the same part, be the fluid containing the urinary excrements for elimination and the nutrient matters for nutrition? Two processes, then, quite incompatible with each other, and opposite in their action, are going on with the same fluid in the same parts of the kidney and at the same moment.

Again, the water descending the convoluted tubules or channels, and in contact with and bathing the free surface of the epithelial cells, is calculated to produce an osmotic current in those cells, the very opposite of that necessary for secretion. The current must necessarily be continous from the free surface towards the attached surface, and, therefore, towards the blood

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* Ludwig: "Handwörterb. d. Physiol.," as quoted in Lehmann.

plasma in the tissues instead of in the opposite direction. If secretion, therefore, is due in any way to the laws of osmosis, it must be brought to a stand-still. So, also, if there be a considerable escape of blood plasma from the Malpighian capillaries, the density and chemical composition of that within the tubes and that in the tissues being the same, endosmotic action must cease.

But to this, it may be said, and very properly, that the nervous force (supposing it to act as the galvanic current is known to do) may make the endosmotic action go on with considerable activity, even under these circumstances. Believing, as I do, in the influence of the nervous force, I am quite willing to give the weight which belongs to this hypothetical answer to my objection.

But the next objection which occurs to me is a much more serious one. Professor Graham and C. Schmidt have proved that urea possesses great diffusive power in water. It is equal to that of common salt. In solutions containing 20 parts in 100 of water, the quantity of the saline solution diffused was 58·68; that of urea was the same; while the solution of albumen was only 3·08.

You are aware that it has been discovered by Professor Graham, that the law of diffusion of gases is also applicable to different neutral salts and other substances dissolved in water. That law is, "that the tendency to diffusion diminishes with the increase of density, being inversely proportional to the square root of the density." It has also been made evident by Schmidt, that gene-

rally when different substances are added to water, the volume of the two combined is smaller than that of the two separately; that, in fact, a certain amount of condensation takes place. Now, there seems to be a law also of condensation. It is, that in proportion to the diffusive tendency of any substance, so is the co-efficient of its condensation.

But urea is a remarkable exception to this; for while its diffusive power is 58·68, its co-efficient of condensation is only 0·160, and that of common salt is 1·505. Its co-efficient of condensation, as found by Schmidt, is the lowest of any substance that has been submitted to experiment.

It is highly improbable, therefore,—it is almost impossible,—that (to say the least) two substances, having such diffusibility through water, should be separated from it by mere filtration, especially such a substance as urea, that admits of no, or but little, condensation with any fluid with which it is mixed. The tendency of such a substance would always be to escape through the pervious walls of a vessel. This I regard as the most serious objection to Mr. Bowman's theory, although I think that the others also are entitled to considerable weight. Now, albumen is the very opposite to urea in respect to diffusibility and condensation. Its diffusibility is remarkably low, being only 3·08 in a solution containing 20 parts to 100 of water,* while that of urea is 58·68; and its co-efficient of condensa-

* Golding Bird's "Natural Physiology," by Brooke.

tion is 0·420,* while that of urea, as I have before said, is only 0·160. Albumen, then, from this condition alone, and independently of other agencies, has a strong tendency to remain within the vessels, and but little tendency to pass through their coats with the water, urea, and salts.

My own idea is (and I mention it with great diffidence, for my subject is not physiology), that, under the combined influence of pressure, quality of blood, and the nervous force, the urinary constituents are separated directly from the Malpighian capillaries, and that whatever constituents of the serum or of the blood are normally transuded through their walls, are *absorbed* by the epithelial cells of the tubules or by some other agents before the convoluted tubes become continuous with the straight or simply excreting ducts, and that the blood, purged and depurated, which leaves by the efferent vessel, while passing through the network of capillaries in the tissues of the kidney, parts with the normal plasma for the usual nutrient processes, as in other organs.†

It is the common practice to speak of these tubules

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* Lehmann's "Physiological Chemistry," translated by Dr. Day for the Cavendish Society.

† Ludwig some years ago propounded a somewhat similar notion—hypothesis—on one ground alone, namely, what may be called the hydraulic theory, or that of pressure. This was evidently insufficient. I shall endeavour to support it partly by this, but, as you might be prepared to expect from my last Lecture, principally upon other grounds.

or channels as mere excretory conduits. This leads to very erroneous notions of their true office. It is probable that the separation of the urinary constituents from those of the serum that may be transuded with them actually takes place in these tubules, and that it occupies some length of time before the urinary constituents, transuded from the Malpighian capillaries, find their way into the straight ducts. These channels are of extreme length, and highly convoluted. I am disposed to regard them more as like the blind tubules of the stomach and other mucous membranes, than as excretory passages, with this difference, that instead of terminating in blind extremities, they communicate with the straight, purely excretory tubes by an open orifice. Not only is a separation of the constituents of the urine probably effected in them, but those matters which are required for the system, and which cannot be lost without detriment, are re-absorbed, just in the same manner that the constituents of the gastric juice, after they have performed their office, are re-absorbed in the lower portions of the intestinal canal for future use; for none of these constituents are normally found in the fæces. We have an analogy for this manner of secretion in some, at least, of the secretions—*e. g.*, the gastric and biliary.

In those secretions which we have been enabled to *see*, the process resembles the one which I have suggested. Take the case of the gastric secretion. According to Dr. Beaumont's, M. Cl. Bernard's, and others' descriptions, from actual sight of the secreting process

by means of fistulæ, when there is no food in the stomach, and the animal has been fasting some hours, no trace of acidity, or indication of the presence of gastric juice can be detected. The mucous membrane is pale and exsanguine, and covered with a layer of greyish mucus, which presents an alkaline reaction. Even when the gastric juice is present during digestion, no trace of acidity can be discovered in the gastric glands, or even below the surface. But, at the moment when the food descends into the stomach, movements are observed to take place, the superficial capillaries become turgid, and the mucous membrane assumes a bright pink colour, and there oozes out from all parts a kind of acid sweat, which raises the thin layer of greyish mucous, and the highly vascular mucous membrane is seen below. Such, in substance, is the description given by all observers of the actual secretion of gastric juice. Previous to digestion, there is no trace of any constituent of this fluid on the surface, in the mucous crypts, in the tubules, in the epithelial cells, or in the underlying tissues. But, at the moment the digestive process commences, the juice exudes from all parts of the surface, apparently from the close network of large capillary vessels — with such rapidity, that, within the hour after food has been taken, the quantity may amount to from two pounds (Lehmann) to seven or eight pounds (Bidder and Schmidt). If all this is "secreted" through the agency of the epithelial cells, they are more potential bodies than even the most firm believer in cell-force could have conceived. It is

much more probable that the secretion comes at once from the vessels under the agency of a nervous current, or some polar force, excited in a reflex manner by the presence of the meal,—something in the same way that the galvanic current acts in producing rapid osmotic currents through animal membranes, apparently in opposition to the laws of endosmose. The character of the secretion is more probably due to the form of network and the size of the capillaries, as influencing the current of the blood, the anatomical and even chemical composition of their walls, and the peculiar character of the nervous currents, than to the protective and perhaps slowly-absorbing cells that lie upon the mucous surface. It is much more probable that the nervous current has far more influence than the epithelial cells in determining the decompositions and recompositions which make the secretions. If we could by any possibility discover the properties of the currents of all the nerves distributed to the several secreting organs, we might find that each has its own special character and property. The same description might apply to the salivary, the biliary, the pancreatic secretion, and even the secretion of milk, which, I grant, is one that offers some appearance of its taking place through the agency of epithelium. The only reason for this is the presence of milky fluid in the cells, and it is reasonable to believe that this fluid is quite as liable to be imbibed by their free as by their attached surface.

LECTURE VII.

COLD AS A CAUSE OF BRIGHT'S DISEASE.

Gentlemen,—The next causes of these Diseases of the Kidney, attended with albumen in the urine, to which I shall direct your attention are cold, cold and wet, and sudden transitions of temperature. You will remember that I placed these under our second category—as affecting the nervous system (and also the muscular system) primarily, and the tissues of the organ secondarily. The term *cold* merely indicates the sensation which we feel when we are surrounded by an atmosphere or are placed in contact with a body less warm than ourselves. In our climate most people feel the sensation of cold when the temperature descends to from 45° to 43° Fahr.

As in the case of scarlatina, I shall speak of the effects of cold upon the system generally; and from these I shall direct your attention to the probable consequences more especially upon the kidneys.

The physiological and pathological action of cold has been carefully observed and studied by many eminent physiologists; and if we apply the effects as seen in parts exposed to view, and witnessed by symptoms the most patent, to the explanation of its effects in parts removed from our view—the internal organs—very

valuable evidence may be obtained of the true nature of the pathological process which these agents induce in the organ with which we are more immediately concerned.

With respect also to the other causes of these diseases, you will find, I think, but few which do not more or less derange the system generally: that the effects upon the kidney are only a part of a general derangement, rendered more intense, more disastrous, and more permanent from the great importance of this organ in the economy, and the peculiarity of its structure.

It is necessary also to keep always before our minds that to a certain extent both cold and heat, as well as moisture and wind, are stimulating, refreshing, health-giving; and that the degree of temperature, humidity, and force of wind, which are calculated to produce these salutary results, will depend upon the age, constitution, temperament, and state of health of the individual. A temperature or other condition of the atmosphere healthful in its operation to one, will be more or less disastrous, or even deadly, to another.

Another circumstance to be considered in estimating the influence of cold as a cause of disease is the state of the atmosphere to which persons may have been previously accustomed; for a sudden transition from an atmosphere of a high temperature to one even moderately cold, is keenly felt, and produces a much greater effect upon the body than a temperature considerably lower would have produced on a person who had been gradually inured to it. To a certain point

both cold and heat resemble each other in many respects in their effects upon the body; and even beyond a certain point, high in the thermometrical scale in the one case, and low in the other, they also have some resemblance. They both paralyze the nervous functions, and destroy the muscular contractility.

The Physiological Effects of Cold.—The first effect of cold is undoubtedly upon the nervous system. But the muscular system very soon suffers also, and the combined effect is an alteration of the circulation, and probably of the blood. Moderate cold and moderate heat are, as I have before said, stimulating,—they exalt the nervous sensibility, they increase the muscular contractility and the force of the heart's contractions, they quicken the circulation, and promote nutrition and secretion. You must always separate, therefore, the healthful from the pernicious influence of these agents. Any undue temperature — either high or low — will depress more or less the nervous system; impair, suspend, or even permanently destroy, the muscular contractility, retard or arrest the circulation, and stop both nutrition and secretion; and every gradation between these extremes may be observed according to the temperature, humidity, and rapidity of movement of the atmosphere, and the constitution, and other states of the individual. And here I will allude to the experiments which Poiseuille made for the purpose of showing the effects of extremes of heat and cold upon the circulation; and by them we may be able to form

an idea of the effects of more moderate but more general and long-sustained applications of these agents in the causation of disease, as we observe them in our temperate climate.

Poiseuille placed some small pieces of ice upon the mesentery of a kitten, the vessels of which were transparent, the temperature of the surrounding air being 22° Centig. (71·6° Fahr.) In a few seconds the vessels (arteries and veins) which previously permitted the passage of two or three globules abreast, allowed only one, and the usual transparent layer of serum next the wall increased in thickness three-fold; these vessels, notwithstanding the action of the cold, did not appear to have diminished in volume. In the capillaries, the circulation at first slackened, and quickly became arrested entirely. On removing the ice, both the arteries and the veins again permitted two or three globules to traverse abreast, as before the action, and the circulation in the capillaries shortly afterwards was re-established. On repeating these experiments on the same animal, and in frogs, toads, young rats, and mice, the same phenomena were invariably observed.

So much for the effect of extreme cold. The following experiments show the effects of heat:—Poiseuille placed upon the mesentery of a toad a thin layer of water, on the surface of which one end of a thin slip of iron was put, while the other end was suspended in the flame of a candle. In proportion as the temperature of the layer of water was raised, the quickness of the current in the capillaries increased; but the heat

becoming so great as to raise a perceptible vapour from the surface, the globules were observed to be stagnant in the capillaries; while some islets, formed by the agglomeration of the globules were seen moving with extreme slowness in the neighbouring arteries and veins, and there were some oscillations observed in them, the extent of these diminished gradually, and they soon afterwards disappeared; the blood was stagnant, and the force of the heart's impulsions could no longer be observed. Probably this was the result of the coagulation of the albumen in the vessels by so high a temperature. It is interesting, however, on many accounts. M. Poiseuille placed the mesenteries and feet of amphibia and mammals in a thin layer of water at 30° Centig. (100·4° Fahr.), and the rapidity of the circulation was so great that it was impossible to distinguish the form of the globules, while in other parts that had not been laid in the hot water, and that had been exposed to the atmosphere, although slightly quickened, yet offered no comparison to that of the current through the vessels of the parts in the water. In these experiments the only difference perceived between the action of heat and cold in the amphibia and mammals was, that in the latter the effect was more rapid, while the return to the normal state took a much longer time. We see, from these experiments, that extreme cold immediately delays, and rapidly arrests the circulation, and, from there being no diminution in volume of the vessels, that it destroys at once the contractility of their muscular coat. Heat, on the con-

trary, quickens the circulation more and more, until it is raised so high as to coagulate the albumen and also paralyze the muscular coat; for it also, when extreme, paralyzes the muscular fibre, and, like cold, destroys its contractility. On submitting muscular tissue to a temperature higher than natural, it has been found that at first its irritability is increased, but on carrying the temperature up to a certain height, varying in degree in different species of animals, it will disappear altogether. In living mammals the irritability seems to disappear at about from 132° to 140° Fahr. What the immediate cause of the retardation of the blood observed by M. Poiseuille may be, it is not easy to say. It is probably due to two causes acting simultaneously; namely, paralysis of the nervous function, and suspension of the muscular contractility of the vessels of the part. The force of the heart may be in some measure diminished by the shock produced in such young animals by the application of the ice to parts so near the great semilunar ganglion, impressions upon which invariably produce a corresponding effect upon the heart. That muscles become paralyzed, and the circulation nearly, if not altogether arrested, and the nervous sensibility perverted, most of you must have had personal experience in the numbness and actual pain, and the blueness of the fingers from handling ice, or from exposure to cold air. That the whole nervous system suffers, we have incontrovertible evidence in the writings of our Arctic voyagers, especially in those of Sir Edward Parry (in the account of his third voyage),

Sir John Ross, and also in those of Barron Larrey. According to Larrey, the congestion, followed by stasis, appeared to operate first upon the brain; but soon, and in some cases almost instantly, upon the lungs also. The symptoms, however, almost invariably commenced in the brain; its action became enfeebled, the intellectual operations were embarrassed, the sensibility diminished, the senses were disordered, motion became more and more difficult, a numbness crept over the whole frame, the poor fellows reeled as if drunk, and ultimately fell down in a state of complete insensibility. Some complained of a severe pain, even when the numbness was great: it was intense, and of a lancinating character. That cold deadens the nervous system, and acts as a narcotic, is well known. The warning of Solander pithily describes this: "Whoever sits down sleeps, and he who sleeps never awakes."

These, then, are the physiological effects of cold. It impairs, suspends, or permanently destroys the nervous function; it impairs, suspends, or destroys the muscular irritability and contractility; it retards or arrests the circulation; and it produces some change in the blood itself. Blood drawn from parts exposed to cold is found invariably to form the buffy coat.

What are its Pathological Effects?—Let us take an example in that frequent effect of cold—Chilblain. The application of cold retards the circulation, a reaction is set up in the surrounding vessels to overcome the retardation; it is insufficient; increased blood-delay

is the consequenee, perhaps aetual stasis; the blood beeomes damaged; exudation takes plaee—in fine, inflammation. This is what we see daily in severe winters in our own eountry. The cold may be so intense, or the eonstitution so feeble, that blood stasis may be the immediate result of the eold; reaetion takes plaees in the vessels of the surrounding parts; all aeeess of fresh warm blood is prevented, and the "frost-bitten" part sloughs off. This is a frequent loeal effeet of eold. How ean we apply this to the explanation of the pathological effeets of eold upon the internal organs? In this temperate elimate the temperature is not often mueh below the freezing point—very seldom indeed is it below zero. But we have moisture, and we have winds. These, undoubtedly, inerease the effeet of eold, whether loeal or general. Water in the form of vapour inereases the condueting power of air, whieh by itself is almost *nil*. It eonduets away the heat of the body, and also the eleetrieity, while it prevents the cutaneous transpiration. You all know the effeet of this. In the first plaee, it is of great interest to us, because normally the skin eliminates from the system a good deal of urea. But with respeet to eold there is an important faet to be mentioned. When the seeretion of the skin is suppressed by a resinous varnish, or by oil, the animals so treated seem to perish from eold; a gradual eooling goes on until the temperature beeomes the same as that of the surrounding atmosphere: it prevents the skin from performing its respiratory and *urinary* function.

With regard also to winds, we are liable to them in this country, from the cold, dry, withering east, and north-east, to the damp, and moisture-saturated south-west. It is difficult to say which of them is the more injurious,—the east and north-east, deprived of their moisture by condensation, and their heat in passing over the high and snow-covered countries of the north and north-east of Europe, impinging particle by particle in quick succession upon the body, and carrying off in its rapid transit its heat and moisture; or the humid south-west, drawing by adhesion its moisture in its course across the Atlantic, carrying off the heat and electricity by conduction, and stopping the cutaneous transpiration.

We have, again, another cause in our climate to make us feel and suffer from the cold. I have mentioned the paralyzing effects of heat. We are exposed to great transitions, not only from the nature of certain occupations, but really from our climate. The body, at one hour of the day, may be suffering from the relaxing, paralyzing effects of heat; and the next, from the equally paralyzing influence of cold. The opposite transition is equally injurious.

The diseases from mere exposure, as found among our Arctic voyagers, were scurvy, jaundice, *chlorosis*, *anasarca*, phlegmon, and gangrene, besides apoplexy and internal inflammations. Now, in our temperate climate, looking to cold as a cause of disease, more especially of these diseases of the kidney, how does it probably act, and what are its pathological effects?

The cold will never be so violent as to destroy the nervous function of the surface, and the muscular irritability and contractility of the vessels, at once. I have already said, in a former Lecture, that I do not think there ever was a case of acute Bright's Disease produced by one exposure to cold, however prolonged, the kidney being previously free from disease, and the body generally healthy. I do not deny that it frequently happens that we have what is called "acute inflammatory dropsy," attended with albumen in the urine, from one prolonged exposure to cold, or cold and wet. But what I contend for is, that previously there existed some alteration of structure in the kidney from the previous action—slow it may have been—of some one or more of the exciting causes of the disease,—it may have been cold itself, or intemperance, or the body may have been weakened from some other disease, or it may have been naturally frail. But suppose cold to have been a cause of disease, how does it act, and what effects upon the organs is it calculated to produce from its known physiological action? We have seen how moderate cold and moderate heat act upon the body: their influence is healthful. We have seen how extremes of heat and cold act: their influence is extremely pernicious, even deadly.

It is extremely desirable that you should have as perfect an idea as possible of the way in which cold produces its effects upon remote organs. You have had evidence of its paralyzing effect upon the nervous

system. Now, I have shown by the striking experiments of Bernard, as quoted in my fifth Lecture (p. 121), that when the nervous function is impaired from any cause, especially when it is arrested by division of the nerve or the application of a ligature, both secretion and nutrition suffer in proportion to the extent to which the nerves are paralyzed, or the nervous force is impaired. It is reasonable, then, to assume, that when the nerves are paralyzed from cold, even when distantly applied, the same effect will follow, and that secretion and nutrition of remote organs will in like manner suffer from this cause, in proportion to the paralyzing influence which it exerts in any case.

You know, also, that the blood, left to itself, and in a manner cut off from the circulation from any cause, rapidly undergoes alteration in its physiological properties. It is probable, nay almost certain, from what we observe daily, that this change takes place from blood-stasis, however short its duration. This seems more than probable from the experiments formerly made by Marchand, repeated since by Müller, and more recently still by M. Armand Moraud, upon the effects of destruction of the nerves of the kidney. We know that when a kidney of an animal is removed it does not occasion any very apparent disturbance; but, what is singular, if, in place of removing one kidney, its nerves be divided, it is constantly and rapidly mortal. Why is this? Section of the nerves is invariably followed by a singular and rapid alteration of the tissues of the kidney; it rapidly suppurates,

and is destroyed.* Such great and immediate results following the section of the nerves, it is not at all unreasonable to assume that when their function is impaired from any cause there will be a proportionate change in the condition of the organ. In the experiments to which I have already alluded, irritation of the nerve interrupted the circulation through the organ, and arrested the secretion, and the kidney became black from congestion. Now, something like this, I am disposed to think, takes place from exposure to cold, or cold and wet, when they act as causes of kidney disease.

In Poiseuille's experiments the muscular contractility of the vessels was destroyed at once by the application of the ice to the tender tissues of very young animals. The application of cold, in the form in which it acts as a cause of disease in this country, is attended with modified results, although, in the main, its effects somewhat resemble those observed by Poiseuille. At first, on the application of cold, especially if combined with moisture, and the air be in more or less rapid motion, the nervous sensibility is increased, the muscular contractility is also augmented, the subcutaneous muscular fibres and the muscular walls of the small vessels contract, and the vessels themselves diminish in volume, and the appearance termed *cutis anserina* is produced. Instead of the current of the blood being

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* "Leçons sur les Liquides de l'Organisme," par M. Claude Bernard.

quickened by the reduced diameter of the vessels, it is slackened from the application of cold, in the same manner as from irritation from any other cause. There is, then, not only a smaller amount of blood going to the skin and superficial parts of the body from this retardation of the circulation, but there is less capacity in the vessels for the blood. The vessels in the internal organs become engorged, and the blood is at the same time overcharged with water which has to be exhaled by the lungs, and transuded in the kidneys. This local application of cold, however, to the surface not only produces a more or less paralyzing effect upon the cutaneous nerves and muscles, it produces, sooner or later, according to the powers of the circulation, a sympathetic effect upon the nervous and muscular system generally—a chill, and more or less rigour, and general spasm. The nervous system directly, and the muscular system indirectly, begin to feel the effect of the prolonged local exposure. It is not for me here to inquire into the physiological cause of this chill. It is not improbable, however, that it may be due to some retardation and congestion in the sensory nerves generally. Now this chill, this *creeping spasm,* I am disposed to regard as the first indications of the internal vessels and muscles being affected in like manner as the cutaneous nerves and muscles were previously affected from the direct influence of the application of cold. It is probable that during every chill from transitory exposure to these agents, or from other causes, as, *e. g.*, from ague, there is a

temporary congestion of the vessels, and suspension, more or less complete, of the secretion, as a secretion; and frequent exposures to cold, or cold and wet, more or less prolonged, may, and undoubtedly do, lead to chronic changes of structure in these organs; and if these causes are associated with intemperance, as they often are, will cause, in the majority of instances, the different forms of *granular* kidney. It would be interesting and profitable to test a sample of the urine passed during the latter part of the cold stage of ague whenever you have opportunities. So far, then, as the muscles are not paralyzed, they contract; the vessels diminish somewhat in diameter, the blood becomes retarded, the nervous system is more or less paralyzed, and secretion is impaired. An effort is now made on the part of the system generally to overcome this. The heart is labouring more and more to overcome this retardation in like manner as in the familiar example of the chilblain, the action of the vessels around the inflamed part became increased. Increased cardiac impulsion is brought to bear upon the retarded or stagnant mass of blood in the capillaries, and increased transudation, or exudation, or actual hæmorrhage, is produced.

This I regard as the immediate effect. But the cause continuing, further reaction becomes necessary. The blood is altered; it contains the elements of the secretion or excretion, an inflammatory process is set up, and various matters become exuded, which may in one situation rapidly become purulent,—in others may

be fibro-plastic,—in others, again, lower forms of albumino-fibrinous matter. These exudates will vary in different individuals according to the constitution and habit of body and previous state of health. At the same time an abundant serosity may be poured into the tissues of parenchymatous organs, or on the free surface of serous and synovial membranes. We may give names to these local and distant effects of cold as we see them in our temperate climate,—chilblain, phlegmon, pneumonia, pleurisy, bronchitis, rheumatism, kidney disease: all of them, however, are only parts of a general state, the local manifestation being intensified by some previous determining condition of the organ, whether from inherent or acquired weakness, or vice, or from some diseased condition of blood. Rheumatism, if lactic acid (?) be present in abnormal quantity; chilblain, when the circulatory powers are languid; and one or other of these kidney diseases, of which we are now more especially treating, if this organ has been over-worked and over-stimulated by alcoholic and allied fluids, whether drunk in excess or imbibed by the lungs in the form of vapour, or whether it has been more or less altered in structure by previous and frequent exposures to cold, or cold and wet, or is degraded by age. And according to which of these causes may have previously been in operation, so will be the form, within certain limits, of the disease, the immediate result of the one prolonged exposure to the withering, penetrating, and paralyzing cold.

And this brings us to the conditions of the kidney

likely to be produced by cold, cold and wet, and sudden and great transitions of temperature. And here I may digress a little for the purpose of saying a few words with regard to these transitions of temperature. To show their influence for good or for evil was partly my object in mentioning the effects of heat. Up to a certain point, so long as it is stimulating and comforting, it is a preservative against cold. The practice in Russia, while the body is heated and reeking with perspiration, of going out and rolling in the snow is an instance of this. The Turkish and Russian Baths are other examples. But we have seen that beyond a certain point, different in different individuals, heat paralyzes the muscles, destroys their irritability and contractility, and especially those of the heart. If, after these conditions had been partially induced, any one were to expose himself suddenly to severe cold, the shock might produce fatal syncope. Individuals are variously affected by heat and cold. The paralyzing, relaxing influence of heat, may be much greater in some individuals than in others. You must take this into consideration in judging of the effects of these agents in causing disease; and I am afraid the want of attention to this will lead to many deaths from the indiscriminate use of the so-called Turkish and Russian baths, administered as they are by persons ignorant of the power of resistance of different individuals to these important agents,—stimulating, refreshing, and healthful when properly used,—more or less pernicious, and even deadly, when improperly applied. I have already

witnessed very disastrous consequences from the injudicious use of these baths.*

The altered forms of kidney produced by these causes will be various, according to the manner of their application, and the constitution, state of health, and habits of life of the individual. Suppose the kidney has been previously sound, and the body healthy, and the individual plethoric—in fact, we will suppose a well-to-do and healthy labourer, of steady and temperate habits and tolerably well supplied with proper food. Such an individual is exposed for a considerable time to an intense cold, which is rendered more potential by humidity and wind. He has been engaged in some exposed situation, in some occupation requiring no very great amount of exercise for many successive hours—slating a house, for example. He may have been exposed during the time to a passing shower or two. What is the form of kidney disease likely to ensue by such an exposure, supposing he happens to be organically diseased at all, and that the kidney, from some accidental cause (it may be from the highly acid state of the urine, or an undue proportion of uric acid, or some other irritant), is the organ most affected? The

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* *The Turkish baths should never be used by invalids, or by persons beyond the middle age of life, without medical advice and under medical superintendence. Hitherto, these baths have been conducted by persons ignorant of medicine. I am glad to find that a Medical Practitioner, of whose knowledge I can bear most favourable testimony, is at the head of an establishment in London and at Brighton. The one in London is in Baker Street, and from personal experience, I can speak most favourably of it.*

blood has been previously healthy, and the fibrin, albumen, and corpuscles in a normal condition. On the retardation of the circulation through the kidney, from more or less paralysis of the nerves, and the muscular coat of the smallest arteries, there will be transudation, abnormal in amount, but of good plasma; and there will be a certain small amount of inflammatory reaction in the larger arteries of the organ, as well as, probably, in the system at large. The secretion, also, will be somewhat impaired; the watery part will be in abundance, and there may be some albumen; the animal principles and the salts of the secretion almost *nil*. Here is the state of engorgement simply, with an abnormal quantity of serum in the tissues.

Suppose, on the other hand, the sympathetic paralysis of the nerves and muscular coat has been more complete and more sudden, or that the condition above described has gone on, and that blood-stasis, with its concomitant arterial and cardiac excitement and increased action, have been produced, and the blood has undergone the usual change; exudation of a fibroplastic matter follows, the engorgement has become inflammatory; more or less extravasation may have taken place, and secretion is all but, if not quite, suspended. We have blood in the urine to such an amount that it becomes solid on standing; or there may not be sufficient fibrin for this, but it may be so highly albuminous as to become solid by boiling. The tubes will be filled and the tissues infiltrated with the same matters, the almost paralyzed nerves will be more or

less pressed upon, the capsule being almost inextensible; the pain, therefore (as we have seen in the frost-bitten fingers), becomes intense. The pain, when these nerves are inflamed, irritated, or pressed, is peculiarly sickening and prostrating; and not only will the nerves of the immediate part be the seat of this pain, but those of the parts proceeding from the same places,—the testes, the thighs, the hips, and the intestines; and the sympathy may be so active that vomiting may take place, and partial syncope. This is not Bright's Disease; it is the old-fashioned *nephritis acutus simplex.* But suppose, through treatment, he recovers from this active condition, but not quite, and the affection becomes chronic, and weeks or months elapse; now he will have one or other of the forms of "Bright's Disease," attended or not with albumen in the urine. It is impossible to say what that form may be. We have imagined a healthy individual, previously of a sound constitution. The subsequent form of kidney will therefore depend upon the length of time he may linger before death occurs. According to my experience, it generally is in the form of the coarse, granular kidney of Mr. Wilkinson King, described by Dr. Wilks, in his very practical and able paper in the "Guy's Hospital Reports" (Second Series, vol. viii., 1852–3),—a paper which ought to be read and studied by every one wishing to become practically acquainted with these forms of disease. It is, however, very seldom that we see a case of this uncomplicated nature. If it happened in a weak, scrofulous person, a low form of albumino-

fibrinous matter would have been exuded, the case would have been less acute from the first, and we should have a large white kidney at the latter stages of the disease, when death takes place; but still it would be more or less granular also,—it would be a mixed form of kidney. Of course, I omit to mention the change in a scarlatinous kidney from exposure to cold; I described that in my last Lecture.

But the kidney may have been suffering from chronic mischief for some time, from one or more of the other causes, and in individuals of various constitutions. We may have in such cases every form of kidney disease that has been described in books,—the large white, the fatty, the waxy, the small granular and cystic, the coarse granular, and so on.

In the next Lecture I shall speak of Alcohol, and the other causes of these affections.

LECTURE VIII.

ON ALCOHOL AS A CAUSE OF BRIGHT'S DISEASE.

Gentlemen,—In this Lecture I shall bring under your consideration the alcoholic compounds, and the other causes of these diseases of the kidney of which I have not yet spoken. As with the causes already considered, so shall I proceed with these. I shall first describe their mode of action and their effects upon the system generally, and then upon the kidney more particularly.

That alcoholic compounds are a frequent cause of kidney disease, as they assuredly are of other diseases, is unquestionable. I do not feel called upon to furnish elaborate statistical tables to prove this. The fact, unfortunately, is but too evident from daily observation; and it is important to know that these compounds are not only morbific when taken into the stomach, but also when inspired by the lungs. I have had ample proof of this in the frequency of these diseases of the kidney in painters, from inhaling the vapour of turpentine while engaged in mixing, flatting, and working in close rooms; in French-polishers, from the vapour of naphtha and alcohol with which their varnish is made; in tapsters, who are constantly drawing the raw

spirit, and serving it over the counter, and may be said to be living in a spirituous atmosphere. You know how extremely absorbent the bronchial mucous membrane is. One of the most striking examples of the influence of alcoholic vapour in the production of kidney disease was presented by one of my out-patients about four years ago. He was a young man about twenty-three or twenty-four years of age, who had always enjoyed good health up to the time at which he entered on the business of a barman. There is no reason to believe that he was a "drinker." On the contrary, he had a great dislike to spirits. After he had been some time in different situations, he went to a large ginshop at Oxford. Soon after he was attacked with dropsy, without any apparent cause, and albumen was found in large quantity in his urine. After being under treatment for some time without deriving much benefit, he was recommended to go to London to consult a physician, who was known to have devoted much attention to these diseases. He continued under the treatment recommended until his means were expended, and he then became an out-patient at the Middlesex Hospital. He was at this time in a situation in a large gin-shop in Charlotte Street, Fitzroy Square, where he was engaged, with many others, in constantly drawing and serving the raw spirit. When he came to me, he was so evidently unfit for his occupation that I recommended his giving it up for a short time. He did so, and in the course of about a month or so the dropsy disappeared entirely; there were no longer any casts of

tubes or blood-corpuscles in his urine, nor was there the slightest trace of albumen. His complexion had regained its usual freshness, and he seemed in perfect health. I recommended him to be extremely careful in his diet, to keep himself warmly clad in flannel and other woollen clothing; and I pointed out to him the extreme danger of drinking spirits or any other fermented liquors. I have every reason to believe that he implicitly followed my directions. A short time afterwards, to my disappointment, he presented himself again, nearly as bad as before in every respect; and, notwithstanding the use of the same remedies, and the same general treatment, which had seemed to be so effectual before, very little change for the better took place until I again advised him to give up his duties. He then recovered rapidly, as before. This experience was not lost upon me. All other circumstances were much as before, except that he was not exposed to the vapour of spirits; and if, in spite of his positive denial, he had been a drinker, he had the same opportunity, I knew, of gratifying his propensity as when engaged in his occupation. I was convinced then that his complaint, if not caused by the vapour of the spirit to which he had been so constantly exposed, was certainly kept up by it, and I recommended his leaving the business altogether and following some other and healthier occupation. He followed my advice, after consulting his friends, who were more than usually respectable for a man in his situation of life, and he has remained quite well ever since. This was the first case that drew my

attention to this mode of causation, and I have had numerous examples since of the same effects from the inhalation of alcoholic compounds, as well as of other highly vaporisable hydro-carbons.

There being no doubt of these compounds being causes of kidney disease, what is their mode of action, physiological and pathological?

Their Physiological Action.—According to current notions, which are founded for the most part upon the theory of Liebig,* supported by the experiments and researches of Bouchardat and Sandras,† and since also by Duchek,‡ the alcohol passes in the system, principally in the blood, through several stages of oxydation, until it ultimately becomes metamorphosed into carbonic acid and water, which are exhaled principally by the lungs. This theory, so plausible, and so satisfactory in many respects, and so calculated to explain many acknowledged effects of alcohol, and supported as it is by the results of direct experiments and chemical analyses made by the first chemists of the day, was generally received as true. According to this theory, alcohol was regarded as an aliment,—one of the tertiary, non-azotised aliments,—and, therefore, subserving

* "Nouvelles Lettres sur la Chimie." Edition Française, publiée par Gerhardt. 1852. P. 244.

† "De la Digestion des Boissons Alcooliques, et de leur Rôle dans la Nutrition." Pp. 448, *et seq.*

‡ "Prager Vierteljahschrift für die Practishe Heilkunde." Prag: 1853.

the processes of respiration and calorification. The successive changes that alcohol was supposed to undergo in the capillary vessels of the system from the oxygen brought by the blood, were into aldehyde, acetic acid, and carbonic acid and water. The carbonic acid resulting from the decomposition of the acetic acid was supposed partly and chiefly to get out of the system in a gaseous state by the lungs, partly to become united to several bases, and to be eliminated by the kidneys and other emunctories. Duchek goes so far as to say that it sometimes becomes converted into oxalic acid. It has been generally observed, that the quantity of carbonic acid in the air expired soon after the ingestion of alcohol or any spirituous liquors is very perceptibly diminished. To explain this diminution, it has been stated that alcohol, by the action of an oxydising body, loses two equivalents of hydrogen, and gives rise to aldehyde:—

$$C_4\,H_6\,O_2 + O_2 = 2\,H\,O + \underbrace{C_4\,H_4\,O_2}_{\text{Aldehyde.}}$$

At a second degree of oxydation, the alcohol loses two equivalents of hydrogen, which are replaced by two equivalents of oxygen, and acetic acid is produced:—

$$C_4\,H_6\,O_2 + O_4 = 2\,H\,O + \underbrace{C_4\,H_3\,O_3,\,H\,O}_{\text{Acetic Acid.}}$$

This transformation of alcohol into acetic acid takes place out of the body, as you know, under the influence

of ferments or dry platinum-black. By a further oxydation, the acetic acid becomes converted into carbonic acid and water, which are ultimately carried out of the system in the way I have already pointed out.

Nothing apparently could be more satisfactory than this explanation, and you perceive how completely it accounts for the diminution of the quantity of carbonic acid. The alcohol takes all the oxygen, and, therefore, the fatty matters cannot be burnt off; they remain in the system to give rise to the drunkard's fatness, whether deposited as fat, or taking the place of the proper organic principles, and leading to fatty degeneration. The whole of the oxygen is used up in gradually converting the alcohol into carbonic acid, which, as it is slowly evolved, unites with the different alkaline and earthy bases, to be finally eliminated by the kidneys and liver. This was supposed very likely to happen when, from the deadening influence of the alcohol upon the nervous and muscular systems, the respiratory movements became so reduced in frequency and extent, that but little oxygen could be introduced into the blood, from the small quantity of air gaining admission into the lungs.

This theory, plausible and satisfactory as it is, has been, I think, successfully proved to be false. It will not bear a searching inquiry into the true facts of the case. And after all, as the sequel will prove, we are obliged to come back to the old opinions, as derived from unbiassed experiments, and before facts were made to square with chemical theories. MM. Lallemand,

Perrin, and Duroy * have made this inquiry in the true spirit of philosophy, and in the most searching manner. It is impossible to read the account of their experiments and analyses without being convinced that they had one object alone in view, and that was truth, apart from any preconceived views or theories. It is altogether out of the scope of these Lectures to quote at length the beautiful, ingenious, and very satisfactory experiments by which they have been led irresistibly to their conclusions. Suffice it to say that the results of their experiments admitted of no other conclusions than those which the authors came to, and which are of great value in explaining the pathogenic action of alcoholic and allied substances. These gentlemen then have found upon evidence, which I do not see how any one can gainsay, that if alcohol, whether in the form of brandy, rum, gin, or whisky, be taken into the stomach, or inhaled by the lungs, it is found as alcohol in the blood and in the tissues, especially in the nervous substance, for which it would seem to have a special attraction: and that it has no claim to be regarded as an aliment. When taken into the stomach some small portion may become converted into acetic acid, by the

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* "Du Rôle de l'Alcool et des Anesthésiques dans l'Organisme: Recherches experimentales." Par Ludger Lallemand, Maurice Perrin, et J. L. P. Duroy. An abstract of the work has been published by M. Racle, who was permitted to see the first part while the original work was passing through the press. But justice demands that the original work should, in all cases, be referred to and quoted, and the authors have the full reputation to which their very elaborate and very able investigations so pre-eminently entitle them.

gastric juice and the mucus acting as ferments. But even this small quantity does not enter the blood. In this list fermented drinks which contain more or less nutrient matter mixed with the alcohol must be excluded, such as wine, beer, cider, perry, etc. Wines contain even nitrogenous matters, with colouring and fatty matters, and salts; cider contains glucose, mucilage, vegetable acids, etc.; beer also contains glucose, dextrine, and allied substances in considerable proportions, nitrogeneous matters, bitter and aromatic principles, and salts. According, then, to MM. Lallemand, Perrin, and Duroy, alcohol is neither transformed nor destroyed in the organism, and is ultimately eliminated without undergoing any modification. They have detected it in considerable quantity in the blood, in the brain-substance when freed from membranes and blood, and in the urine, by means of distillation; they have shown afterwards by the aid of exact doses analogous to the process of analysis by the volumetric method, that alcohol diffuses itself in the tissues, and that it accumulates in the brain, and in the liver, where it is found in larger quantities than in the blood and other organs. They have proved by multiplied experiments, verified by counter-proofs, that alcohol does not undergo any modification in the economy, and that it does not give rise consequently to any bodies resulting from its oxydation, such as aldehyde, acetic acid, etc. These authors have shown, moreover, that it is eliminated unchanged by the lungs, the skin, and the kidneys. It was not only after the

ingestion of a *great* quantity of alcohol, that they met with it in the organs, for they found it in the blood of a dog, nine hours after he had taken only 30 grammes (3 drachms $37\frac{1}{2}$ grains) at 21°; they met with it in a man who had drunk about 30 grammes (about $3\frac{1}{2}$ drachms) of brandy; they observed, finally, that the pulmonary exhalation of a man who had taken a litre ($\frac{7}{8}$ths of an imperial quart) of wine, of a middling alcoholic richness, contained alcohol for eight hours after taking it, and that the urinary secretion gave evidence of its presence during fourteen hours. The authors may well ask,—"Is this the mode of action of an aliment?" All the tests for the detection of aldehyde and acetic acid were had recourse to after alcohol had been administered in various ways, and in every dose, but without avail; whereas, when very small quantities of these substances were administered, evident indications of their presence in the blood, and in the organs, and in the exhalations from the lungs were at once observed.* I have already described how the diminished quantity of carbonic acid exhaled after the ingestion of alcohol, was explained under the old theory. It remains to show how the diminution can be accounted for under these observed, indisputable facts. Now, it appears, from the researches of MM. Lallemand, Perrin,

* Since writing the above, the conclusions at which these experimenters have arrived have been confirmed by the very ingenious experiments of Dr. Edward Smith, performed before the Medical Society of London.

and Duroy, that alcoholic substances exert a very remarkable action upon the blood, which presents in animals alcoholised numerous globules of fat, like cholesterine, visible to the naked eye, and swimming on the surface of that fluid. This is of such interest in connection with our subject, that I shall again refer to it when I come to speak of the pathological effects of alcohol. At present it is in its physiological aspect that they are of importance. Since alcohol produces a modification so singular, may it not offer also, when present, an obstacle to the disengagement of carbonic acid, or delay even the combination of oxygen with the carbon of the blood? If this be the case, alcohol contributes to nutrition, not actively as an alimentary substance, but in an indirect manner in exercising a moderating influence upon organic decomposition. With respect to its influence independent of this separation of the fatty principles, and perhaps their conversion into a non-saponifiable state, but little is positively known. It is conceivable, however, from the properties which alcohol is known to possess,—its great diffusiveness through, and attraction for, water,—its power of dissolving some very important animal principles, and of coagulating others,—that it does exert a considerable influence upon the physical, and also probably upon the chemical qualities of the blood, and blood-corpuscles. Nothing definite, however, has been observed. Dr. Addison, of Brighton, whose able researches have thrown light upon some physiological and pathological processes, has observed some very curious effects upon

adding sherry wine to blood out of the body;* and it is possible that alcohol, when taken into the system in large quantities, may in time work such changes, and even destroy the red corpuscles already formed, and hinder the full development of others. MM. Lallemand, Perrin, and Duroy, however, saw no alteration in the corpuscles, even when alcohol was added to the blood out of the body, nor in blood taken after large quantities had been imbibed.

Poiseuille's experiments proved that its mixture with the animal fluids both when directly injected into the blood-vessels, and after being taken into the stomach, retards the circulation through the capillaries, although its first effect is to excite the heart to increased action. It diminishes the want of food, and impairs or destroys the appetite for it. Bouchardat remarks that the alcohol acts by diminishing and suppressing probably the functions of absorption by the stomach in respect of every other substance; it augments, on the contrary, the secretion of that organ; and from these conditions arise the increased secretion of mucus, the disgust for food, and the emaciation. Of course, such liquids as beer, some wines, and cider, and other nutritious and true alimentary and fattening drinks, are not included.

That it affects the nervous system, and indirectly, if not directly, the muscular system also, I need scarcely mention; it is too often rendered obvious to us. A

* "Gulstonian Lectures on Fever and Inflammation."—*British Medical Journal*, 1859.

moderate quantity produces an excitation of the nervous system, which extends over the whole economy; a still larger dose produces great disturbance of the cerebral functions, which another and still larger dose completely annihilates. The same effects nearly are observed upon the muscular system. A moderate dose seems to impart strength to the muscular contractions, while a very large dose destroys all voluntary contractility, and a poisonous one that also of the involuntary muscles. Flourens's experiments upon the effects of alcohol upon birds are very instructive. Its effect upon them resembled that produced by the removal of the cerebellum, except that in the latter case the intelligence remained, while with alcohol, I need not say it was destroyed. In poisoning by alcohol the respiratory movements and those of the heart were the last affected,—those of the heart the last. Even for some considerable time after respiration had ceased, the heart continued to beat. In the experiments which I made upon the frog, which some of you witnessed, the heart continued to beat, and the circulation went on for some time after respiration had ceased.

Its Pathological Effects.—That alcohol is a local irritant is unquestionable, and that it produces its effects upon the system partly in this way is very probable. It may act remotely by sympathy to some small extent, as Orfila believed. But we have seen, from the very able researches of MM. Lallemand, Perrin, and Duroy, from whose book I have already quoted so largely, that it is rapidly absorbed by

the venous radicles, and that its principal action is directly upon the different organs which it irritates, and eventually inflames. Especially has it been proved to be present in greater proportion in the nervous tissue than elsewhere, which it more particularly excites. It disturbs its functions; it perverts and ultimately destroys the intellectual and even the emotional faculties; it disturbs the function of the sensory nerves, both common and special, as shown by subjective tactile phenomena, strange perversions of taste, double vision, and other disorders of the optic nerves, tinnitus aurium, and other disorders of the auditory nerves. It equally disorders and destroys the function of the motor nerves, as shown in irregularity, and absence of consentaneous action of the movements. From these effects upon the cerebro-spinal system, it is more than probable that it disturbs and impairs the functions of the organic nervous system, as evidenced by defective nutrition and secretion. When taken in the form of brandy, whisky, gin, and such fluids, it impairs nutrition, probably from its great attraction for water, inspissating the blood and juices of the body. I need not mention in what large proportion water enters into the composition of the tissues and fluids of the body. It is probably in this way that it acts as a diuretic so far as the increase of the watery part of the urine is concerned, not only from the increased quantity of water ingested with and after the brandy, but from its abstracting it from the tissues. There is no doubt that it tends to harden the

brain substance, and to produce atrophy of many of the structures, not only by increasing the quantity of connective and other white fibrous tissues, and so leading to undue pressure upon the more important parts, but by condensing the tissues directly by the abstraction of water. There is no doubt of its exerting this destroying influence upon the liver. I shall endeavour to show you that it does so upon the kidney also. As a general rule, it irritates and inflames the tissues of the stomach and duodenum, and even the pancreatic and hepatic ducts, and it probably affects and deteriorates the secretion of these glands. It produces hypertrophy of the connective tissue forming Glisson's capsule, which, in its turn, presses upon the small vessels, and upon the hepatic cells, and produces atrophy of these anatomical elements in two ways; first, by cutting off the supply of nutrient materials, and, secondly, by absorption from pressure. It probably exerts a *direct* effect upon these cells, leading to their destruction, independently of those produced by the thickening of Glisson's capsule. The digestive processes are probably still more impaired by the bad quality of the bile and pancreatic secretion.

Now, very much the same changes take place in the kidney as in the liver and other organs. We have seen that alcohol passes through the vessels and tissues of this organ as alcohol; it irritates these tissues, as it does similar tissues in other parts; it leads to blood delay; it impairs the influence and function of the nervous system; it produces hypertrophy of the con-

nective tissues, forming the stroma or framework of the organ and of the capsule; and it produces a granular appearance precisely as it does in the liver. In fact, this alteration is very commonly seen in both these organs in old drunkards, especially and almost exclusively those who take the raw spirit in large quantities, or spirit mixed with only small quantities of water. Those who drink largely of beer, and perhaps of wine, are found to have a somewhat different form of kidney from those who drink it in other forms, especially when taken as gin, brandy, &c. But we have seen that alcohol separates and modifies the fatty matters of the blood. MM. Lallemand, Perrin, and Duroy have seen this. Most pathologists believed that so far as the relation between cause and effect could be traced, it was almost certain that alcoholic beverages, when largely and continuously consumed for any length of time, led to fatty degradation. This separation and alteration of the fatty principles of the blood have now been actually seen and proved, and probably play a very important part in the pathological effect of alcohol when taken in large quantities, in the form of brandy, gin, whisky, &c. Saponifiable fatty matters, that are visible to the naked eye, are calculated to impede the circulation through the capillaries—if not to cut off the blood-supply altogether,—and so produce atrophy of the secreting tissues, while the connective tissue, supporting the vessels, would receive an undue supply of blood plasma, and therefore become hypertrophied. It is not improbable that some of these fatty matters

become transuded with the exudates, and thus lead to the presenee of fat in the tubules, and also in the inter-tubular substance; some may also remain in the walls of the eapillary vessels, and replaee in time the normal elements. We had a ease in Cambridge Ward in the summer, whieh most of you witnessed, and whieh offers a striking example of this, for large fatty particles eould be seen by the naked eye floating upon the surface of the blood. This man, whose name was Beck, was admitted on the 25th of May. On his admission he was eonsidered almost moribund. The dyspnœa was extreme, and so was the anasarea. There was evidenee of enlarged heart, and of extreme œdema of the lungs, and of effusion into the left pleural eavity. Many of you will reeolleet the opinion I gave as to the nature of the ehanges that we should find in the kidney. Aeeording to his own eonfession, he had drunk immensely, prineipally of gin; but he was not at all partieular. He was a musieian, and in the habit of playing at dancing parties; but he was always well off, lived well, and, exeept at times, when he was more drunk than usual, he was not liable to exposure to cold. He had had eleven ehildren, but they all died in infaney or early ehildhood. From the eause alone in this ease you will reeollect that I ventured to state what would be the eondition of the kidney after death. At that time we did not expeet that he would live many days. He, however, rallied for a time, but died eventually on the 29th of the following month, the immediate cause of death being an attack of bronehitis. During his stay

in the Hospital, we had opportunities of confirming the diagnosis by the examination of his urine, and by the general symptoms and signs. I told you that the kidneys would probably not be enlarged, and that they would not vary much from the normal weight. I stated that they would be found to be extensively granular, that there would be numerous small cysts, that the cortical portion would be much reduced in thickness, and that there would be a considerable quantity of fatty matter in them. This turned out to be an accurate description in every respect. Although this man was a drunkard, by his own confession, yet it was impossible to see much of him without being convinced that we had got the whole truth from him. You will recollect how he won the regard of all who watched his case, from the patience with which he bore his great sufferings, and the intelligence and other good qualities which he evinced. There were several other circumstances of interest connected with the diagnosis in this case; but as I only quote it for the purpose of alluding to the spirit-kidney, I do not think it necessary to speak of them now. In persons who become the subjects of kidney disease from the excessive consumption of beer, another form of kidney is found. Instead of the small granular kidney, with its cortical portion diminished, it is generally a mixed kidney, something between the large white kidney, which we see after scarlatina, and the true granular kidney, with more or less of fatty deposit, both in the tubes and in the interstitial tissue.

Never overlook, in seeking for the mode of causation

of these diseases, the great influence of the sympathetic nerves—the greater and lesser splanchnic and even of the par-vagum—upon the secretion, and, if any cause is in operation to interfere with the function of these nerves, how the circulation of the organ is necessarily affected, and therefore its secretion also. I have now given three of the most important causes; I may say, perfect types of their respective kinds. One, namely, scarlatina, is an example of our first category,—those whose action is upon the blood primarily, and upon the nervous system and the tissues of the organ secondarily; another, namely, cold, is an instance coming under our second category,—those which affect the nervous system primarily, and the blood and tissues secondarily; and, thirdly, alcohol and its allied compounds, which may fairly be said to partake of the character of both these modes of action, and, indeed, of the third also. Perhaps, with strictness, it ought to be placed under our second heading.

It now only remains for me to give you an example under our third class, those which, either by direct or reflex action, affect the tissues of the organ primarily, and its own nerves secondarily.

The key to the action of these causes is to be found, I take it, in these quotations from M. Claude Bernard:—"Albumen is constantly in the urine, and the tissues of the organ, and its blood-vessels become turgid and black every time that we irritate the substance of the kidney. If, leaving the organ intact, we even irritate its nerves, the same effects ensue." "If the function of the

nerves be suspended temporarily or permanently, the secretion of the kidney will be arrested, and the circulation also, and the organ will be rapidly destroyed." Consider the effects of such direct irritants both upon the nerves and structures of the organ as alcohol, turpentine and cantharides, even excess of uric acid, as in gout, in connection with these results of experiments performed by M. Claude Bernard, and you can have no difficulty in understanding their mode of action in the production of these kidney diseases.

The same may be said of those disordered states which act by producing reflex irritation. Calculi in the pelvis of the kidney, the ureter, or the bladder; catarrhal affections, gonorrhœa and so on; dysmenorrhœa, and even Onanism and excessive venery.

You are aware that the renal plexus is chiefly formed by the solar plexus and the lesser splanchnic nerves, and that the renal plexus gives branches to the spermatic plexus: hence the morbid sympathies which exist between the kidney, the ureter, and the testicle; and, by the communications with the solar plexus, with the stomach and diaphragm, and, indeed, with the whole system. You will not fail to perceive, then, how any irritation in the ureter, the testis, the uterus, etc., is calculated to give rise to reflex irritation in the kidney, and *vice versâ*.

In the next Lecture, I shall give a cursory review of the several forms of kidney, the result of one or other of the several affections coming under the general denomination of Bright's Disease.

LECTURE IX.

ON THE DIFFERENT FORMS OF DISEASED KIDNEY INCLUDED IN THE GENERAL DENOMINATION OF "BRIGHT'S DISEASE;" THEIR ANATOMICAL CHARACTERS AND SYMPTOMS.

Gentlemen,—It is not easy to give in words an intelligible account of the several forms of Bright's kidney, which have been described by writers, and to which I have made allusion in previous Lectures. You are aware that since I have occupied the Chair of Medicine in this College, jointly with Dr. Stewart, I have been in the habit of describing the several forms of diseased kidney included in the general denomination of Bright's Disease, as modifications, or a more or less extensive commingling of two leading typical forms, commonly and very aptly termed the large white kidney, and the small, hard, contracted kidney. I say modifications, or a mixture of these two, but not gradations; for, I believe, from an experience of some years, and somewhat close observation, that Dr. Bright and his followers (especially Dr. Wilks, whose very able and painstaking investigations of these pathological conditions of the kidney entitle him to rank among the highest authorities on this subject) are quite right in their opinion, that these two forms are essentially different, and never pass by any pathological process from the one to the other. In entertaining this opinion

however, I do not ignore the faet that the process which leads to the onc form may be engrafted upon the other, or that from speeial eauses, eonstitutions and states of body, the two proeesses may go on contemporaneously, and so form a mixed kidney—that is to say, a kidney having a more or less elose resemblance to both these forms, either in the same or in different parts. Now the essential anatomical characters, speaking roughly, of these two forms of kidney, and the symptoms and signs by which they may be respectively reeognized, are the following:—

1. *The Large White Kidney.*—It is, as its name implies, larger than the normal kidney, often double its normal size, and varying in weight from six to twelve ounees, or even more; its external, eortieal, or seereting part is increased at the expense of the internal, medullary, or purely exereting parts, measuring generally between the basc of the pyramids and the investing capsule, from half-an-inch to an inch or more; it is of a whitish, or yellowish-white colour, flaccid, and anæmic, partly from the obliteration of the vessels, partly from more or less abundant serosity, and partly from the diminution in the amount of blood-eorpuscles. There may, however, bc, and there often are, a few enlarged and turgid veins, which in the interior arc tortuous and on the surface have an arborescent form; the medullary portion may present various degrees of engorgement, or may be as exsanguine as the cortical portion, but this, so far as my experience goes, is rare.

These are the broad essential characters of the large white kidney, at the stage at which we most frequently find it after death. But it is necessary to say that this form of kidney, which in its typical condition is in nearly every instance caused by scarlatina, or follows that disease from exposure to cold, or error in diet, &c., may be met with in, and in some cases exhibits and passes through, different stages, much in the same way as Frerichs describes in his book (*Die Bright'sche Nierenkrankheit, und deren Behandlung*). The fault into which this eminent physician fell is, that he regarded all the forms of Bright's disease as different stages of this one. Now, I shall endeavour to show that the kidney even in the stage of atrophy of what has been the "large white," is due to quite a different disease, to a different cause, and has a different history from the *small, hard,* and contracted organ. The distinct recognisable stages through which this kidney may pass is almost invariably two. In some rare instances a person may survive the second stage,—the kidney will then exhibit an appearance which I shall describe by-and-by.

In the first, or acute stage, the kidney is enlarged; in the adult its weight may be increased to from six to twelve ounces, instead of its normal weight—about four ounces; in young persons and children the increase will be in proportion to the age. Its consistence is tolerably firm; its surface smooth, of a more or less deep suffused redness, very numerously interspersed with minute points of a deeper red. The capsule,

which may be a little more vascular than natural, may be easily detached.

On section the increase in size will be found to be due to the enlargement of the eortieal substanee. This substance is minutely injceted with blood, and presents a uniform redness, with numerous dots of a deeper red—engorged malpighian bodies. Sometimes there may be seen portions of a lighter shade of colour, from exudative matter. With this general state of engorgement there may be aetual extravasation in the malpighian capsules, in the tubules, and even in the intertubular substanee. The pyramids are also redder than natural, and the mucous membrane of the ealyces and pelvis is injected. The epithelium will be found in large quantity in the tubes, mixed with fibrinous matter and blood, and perhaps with minute crystals of lithie aeid, or of oxalate of lime.

In the second, or typical stage, the organ is still more enlarged; but instead of presenting the sanguineous redness of the first stage, the cortieal substance is paler than natural, of a whitish, or yellowish-white colour, and is still more thiekened—it is somewhat soft and friable, and, on pressure, a turbid, milky-looking fluid exudes from the eut surface. The exuded matter is deposited almost entirely in the cortieal substance both in the convoluted tubes and between them, and this, doubtless, gives to this portion of the kidney its inereased thiekness. This matter also is found dipping down between the pyramids. These last present a radiated, striated appearance, which has been described

as resembling a plume of feathers. In the cortical substance there will be observed numerous whitish lines proceeding from the surface inwards, some of which, on minute inspection, will be found to be due to numerous isolated whitish *puncta,* while others are uninterrupted in their course. I have no doubt but that the former are malpighian capsules, distended with, and probably surrounded by, exudation-matter; and the latter are caused by tubes filled with the same kind of matter, and also the same exudate between the tubes, which also assumes a linear arrangement. Do not suppose that this linear arrangement of the exudate, when situated in the intertubular substance, can be impossible from the rich network of capillaries. This network lies on a different plane. So far as I can discover by a very attentive examination of portions of the cortical substance in which the capillaries and tubes are injected, they appear respectively to lie on different and alternate planes. The whitish lines of exudate seem at times to penetrate even between the straight tubes of the pyramids, separating them from each other, and so giving rise to the feathery expansion of their bases.

The pyramids are of a reddish colour, of different shades in different cases.

The vessels of the cortex are extensively obliterated.

In this stage we scarcely ever meet with a kidney in which the exudate has not undergone more or less the fatty metamorphosis.

Now, it is possible, and it is not very infrequent, for a person to survive this, the typical stage of the "*large*

white kidney." The imperfectly and lowly organized exudate may become more and more fatty, and this again may become absorbed, and in this way a wasted, shrivelled, flaccid, toughish kidney may be formed. It is possible also, as I have before said, and as I have (I think) frequently seen, that from exposure to other causes another form of inflammation may be set up, and another kind of exudate formed, which may be capable of being organized into a fibrous growth, and thus a fibrous structure may be grafted upon the other, and a mixed form produced. This is the kind of kidney (as I think) which Frerichs has so well described as his third stage of Bright's kidney. But the kidney presents under both these conditions, a very different appearance, and a very different structure from those which characterize the typical small, *hard,* and contracted kidney, although its size and weight may be reduced from eight to twelve or more ounces, to the normal weight and size, or even considerably below these.

The Microscopical Appearances of the Large White Kidney.—The malpighian bodies are irregular in size, some being excessively enlarged, others being smaller than natural. Their capsules are more or less distended with granular matter, and so also are the tubes. The tuft of capillaries seems wasted, and only a few large distended ones are visible. This is very evident in injected specimens of diseased kidney (Pl. II. Fig. 5). It rarely, if ever, happens, that with this granular matter we fail to detect more or fewer fat globules,

some of them being of extreme minuteness. In the majority of the cases, these fat globules greatly preponderate over the other components of the degraded exudate. The tubes are empty, and compressed in places, but in general are greatly distended with altered epithelium, mixed with granular matter more or less fine. Here and there a tolerably healthy capsule and tube may be observed close to one that has undergone the changes just described. In the field around the section may be observed a quantity of epithelium, more or less altered, some cells being considerably larger than usual, and containing varying quantities of oil, others shrivelled, and otherwise imperfect in form, and all more or less granular. Lines of the same kind of granular matter may be often observed between the straight tubes.

Symptoms and Signs characterizing the Acute Stage of the Large White Kidney.—Acute Anasarca after Scarlatina.—From about the eighteenth to about the twenty-first day from the commencement of the attack of scarlatina, or from about the fourteenth or fifteenth from the commencement of desquamation, and generally shortly after exposure to cold, a person is attacked with more or less febrile heat, frequent chills, headache, pains in the limbs, quick, full pulse, hot skin, and scanty and high-coloured, often bloody, urine, micturition is frequent, but a few drops only may be passed. If the urine be examined at this time, and before the anasarca has occurred, albumen may in nearly every

ease be observed. In some rare cases, and perhaps under peculiar circumstances, or in peculiar constitutions and states of health, these symptoms may come on from a prolonged exposure to cold, independently of any previous scarlatina.

In the course of a few hours, or of a day or so, according to the severity of the attack, general anasarca makes its appearance — the whole body is swollen. There may be vomiting, and the bowels may be either relaxed, or they may be confined. There is generally more or less pain in the loins extending down the hips, or there may be only a sensation of uneasiness or of weight in this situation. This pain is generally increased on pressure. Now, this acute form of dropsy takes a rapid course unless it be relieved speedily. In some cases the febrile symptoms are scarcely complained of, and there may be very little general anasarca, and the disease seems to have begun with headache, more or less intense, speedily followed by epileptiform convulsions. The urinary secretion may be all but suppressed, and the small quantity which is voided is red, contains numerous blood-corpuscles, blood-casts, and it may be granular and imperfect epithelial casts, and is, of course, highly albuminous—in fact, may in many cases be almost rendered solid by boiling. The specific gravity may be as high as, or even higher than, in health.

In a short time symptoms of cerebral mischief supervene. The face becomes more flushed, the head hot, the eyes suffused, twitchings of the muscles generally,

and particularly of those of the face, occasional strabismus, and ultimately epileptiform convulsions, alternating with a comatose state more or less profound. If not relieved, these convulsions become more and more powerful, until death takes place from asphyxia, or from cerebral hæmorrhage. The uræmic poison in this the acute form of dropsy seems to act upon the nervous system in a different way from what it does in the chronic form of dropsy. The urinous excrement seems not only to lead to pressure from the blood retardation and congestion of the vessels which it produces, but it seems actually to irritate, or to be baneful to, the nervous substance itself. In this form we have epileptiform convulsions referrible to irritation of the nervous pulp, in addition to the coma from pressure; while in the chronic form convulsions very rarely precede death: the patient dies from coma alone. The pupil, too, in the acute form, is almost always contracted, while in the chronic form of dropsy, although it is generally more or less contracted, yet it is frequently much dilated.

Symptoms and Signs of the Large White Kidney in its Typical or Chronic Form.—If, from the effects of treatment, or from other causes, the acute disease do not end fatally, and yet the albumen still continues to be found in variable, but considerable, quantities in the urine, and there be more or less anasarca, that change which I have described as the typical stage of the *large white kidney* will gradually be produced, and will be

indicated by the following symptoms:—the general surface will be puffy, the skin will in general be dry, and with difficulty made to perspire; the pulse will be small, hard, and irritable, ranging from 90 to 100, or 110; the tongue will be coated with a creamy-white fur, red and irritable at the sides and tip; there will be thirst, pain and sensation of tightness and distension in epigastrium and right and left hypochondria; almost constant nausea, and frequent vomiting, especially after food; intestinal flatulency, looseness of the bowels, frequent attacks of diarrhœa, rarely constipation; and when this happens to be the case, there is generally effusion into the peritoneal cavity. There is constantly more or less bronchitis, and frequently œdema of the lungs, as well as pleural effusion. The cardiac dulness is increased generally from enlargement of the heart, frequently also from pericardial effusion. The abdomen may not only be enlarged from flatulent distension and œdema of the walls, but also from peritoneal effusion.

The *urine* is ordinarily of a pale-yellow colour, generally turbid, and may still be a little "smoky." By some authors the urine is represented as possessing a certain odour, according to some, like that of whey, to others, of boiled beef, weak broth, &c. This is a very fallacious and useless test. In the specimens which have been submitted to the noses of many persons at the same time, you may have heard as many different opinions and fancied resemblances. It varies in quantity very much in different persons, but especially at

different periods of the disease. It is rarely below the average, except towards the close of life, often above it, and not infrequently considerably so. After remaining at rest for some hours, there is generally a sediment, which is found to consist of kidney epithelium more or less disintegrated, a few blood-corpuscles, mucous globules, and sometimes a few pus-corpuscles; fibrinous cylinders, some being clear and small, others being granular, and others again studded with imperfect and granular renal epithelium; and frequently both the cells and all the casts will be found to contain more or fewer oil particles in varying sizes, some being extremely minute. If there happen to be many tubes of large size, and if there be a considerable amount of oily matter in them, it will be a certain sign that the kidney is in a far advanced stage of disease. (See Pl. I. Figs. 1, 3, 4, 9, 10, 11, 12.) The albumen is generally abundant, but less so than in the more acute stages of this form of kidney, and forms a much lighter and finer precipitate on boiling, and by the addition of nitric acid. The anasarca is always considerable, and goes on gradually increasing until the close of life. The quantity of urea voided daily, as deduced from a considerable number of trials during the last six months, is always considerably below the average, as is also the proportion in a thousand parts. The course of this disease is generally rapid; the duration is seldom more than from four to twelve months. If, then, with these symptoms, you have a history showing that the disease had its origin in scarlatina, or fol-

lowed prolonged and frequent exposures to cold, the constitution being feeble from original or acquired vice of blood, and if at the same time you find the urine possessing the characters which I have just described, you may, with tolerable certainty, pronounce that your patient is suffering from the *large white form* of diseased kidney, and give your prognosis accordingly.

2. *The Small, Contracted Kidney.*—It is invariably smaller than the normal kidney, sometimes only half, or even less than half, the natural size; it is hard, contracted, red, and granular; the external or cortical part is wasted without any corresponding increase of the tubular portion. The capsule is in general thickened and opaque, and is separated with great difficulty from the surface. In nearly every case, in endeavouring to separate the capsule, more or less of the substance of the kidney is torn away with it. This is easily explained. The fibrous capsule being continuous with the fibrous stoma, if they are both thickened from the coarser fibres of which they are normally composed, as well as from development of a new fibrous growth, the difficulty of separating the one from the other will be proportionately great. The substance of the organ is tough, and presents a coarse, fibrous, and granulated appearance, even to the naked eye. The blood-vessels are even more impervious to injection than in the large white form of kidney. When examined by the microscope, the fibrous structure is very evident, and presents

the appearance as figured in Plate I. Fig. 21. The tubules will be found to be packed together, almost, if not quite, solid, and formed into fibrous cords, while in other parts they are sacculated or varicosed (Plate I. Fig. 15), many of the sacculated expansions being cut off from those above and below them, and so forming independent cavities or cysts. The tubules, for the most part, are bare of epithelium,—not that it has been shed, but from its no longer being formed. If there be still some epithelium, it is imperfect, shrivelled, and granular. The walls of the tubes are puckered, and present an irregular outline.

The process leading to this form is chronic in its nature, its duration occupying many years, and is very seldom found to take place without evidence of a similar process in other organs, especially in the liver, and not unfrequently in the spleen and heart; and it is more than probable that these have been affected contemporaneously with the kidney, from the influence of some cause affecting the body generally. You will recollect that I ascribed this form of diseased kidney more particularly to the abuse of alcoholic drinks. I am led to believe that a slight modification of this form is produced by mechanical causes, which prevent the return of blood from the vein,—as from enlarged liver pressing upon *inferior cava, emphysema,* and regurgitant disease of the mitral valve.

The symptoms of this form are somewhat obscure, certainly not so evident as those characteristic of the other and more acute form. They are more of a

secondary character, and referrible to remote organs rather than to the kidney itself, from the effects of the disease and the retention of the urinary constituents, upon the blood and upon the nutrition of the body. The general tissues of the body suffer degradation, and the subjects of the disease are cut off by some other malady, as apoplexy, or other head affections, pneumonia, pleurisy, pericarditis, peritonitis, &c., to which they have become predisposed, owing to the general dyscracia produced by the insidious and unsuspected progress of the kidney affection; they die from pyæmia, erysipelas, or other causes, after accidents or surgical operations, which are not in themselves mortal, and not usually followed by a fatal result. The urine in this form is, as a rule, as abundant as in health, sometimes even more abundant; it is of low specific gravity; it may or may not contain albumen. Generally, the only effect of applying heat and adding nitric acid is to render the urine slightly opaline, but to produce no sediment or actual precipitate; it scarcely ever contains any casts of tubes, either epithelial or exudative. There is very seldom any anasarca. If there be any, it is small in amount, and then generally only at the close of life. But in many cases, on looking attentively, you may, as I have stated in a preceding Lecture, detect a slight œdema beneath the conjunctivæ, and in the feet towards evening, and a general puffy condition of the eyelids and of the loose subcutaneous tissues. The more positive or evident symptoms and signs of this form are pallor, neuralgia, headaches resembling those

characteristic of hemicrania, noises in the ears, motes before the eyes, and other symptoms referrible to the nervous system, dyspeptic and other symptoms indicative of gastric and intestinal irritation, and even inflammation; for even extensive ulceration of the stomach is occasionally found with this condition of kidney, but whether it be an effect of it, experience has not enabled me to decide, although it is not improbable.

3. *Mixed Form.*—As I have said and indicated in preceding Lectures, every kind of modification of these two forms may be met with, but never any true gradation from the one into the others,—that is, from the large white, or most acute form, into the hard, contracted, and more chronic disease. There may be, from some peculiarities in the nature of the cause, the habits of life, and constitution of the individual, a state partaking of both characters, or the one process may attack a kidney previously the seat of the other process, and so in a manner become engrafted upon it, in which case the organ will of course present the characters of both, and so constitute a third form. It may or may not be larger than normal; generally it is. It is much less pale than the large white; its vessels are much more numerous and more or less gorged with blood; the Malpighian tufts are red and solid, and the organ presents a coarse granular appearance. The symptoms, as you might be prepared to expect, are much less acute than in the large white form, and more decided than in

the purely chronic form. The urine is very seldom free from albumen,—it may contain a very considerable quantity; the specific gravity is considerably under the average, but never so constantly low as in the small contracted kidney; there is almost always more or less deposit of albumino-fibrinous casts of tubes both large and small, and also casts of imperfect broken-down granular epithelium, in which there are generally some minute fatty molecules, and a few isolated blood-corpuscles. There is commonly considerable anasarca, with great proneness to effusions in the serous cavities, and even inflammatory formations, as flakes of lymph, &c.

Besides these two leading, typical forms, and the third or mixed form, there are two others mentioned by writers, namely, the Waxy, Lardaceous, or Amyloid kidney, and the Fatty kidney. These may be modifications of the first form (the large white), or they may be produced by an independent morbid process. They much more rarely accompany the hard, contracted type of kidney.

You will perceive that the terms lardaceous, waxy, and amyloid are synonymous, and are used to indicate the same disease. The first was used originally by Rokitansky, from the supposed resemblance of the kidney, when so affected, to bacon rind. The second was a name given to it by some English pathologists from a fancied resemblance to wax; and the third is the term given to it by Virchow, because of its offering reactions on the application of iodine and sulphuric acid,

resembling, if not identical with, those of the same agents upon starch.

This form of kidney must be rare, for I have not met with it in my practice at this Hospital in such a way as to be evident to the naked eye. But now that we have the means of detecting this degeneration even when partial, and before it has become so general as to affect the whole cortical substance, so as to be apparent to the naked eye, we shall doubtless find it more frequently; for I have for some time had the impression that this metamorphosis must be frequent in scrofulous and phthisical patients, and have often been surprised at not discovering palpable evidence of it in the dead-house.* Virchow says "that a large proportion of the cases of Bright's Disease, especially the chronic ones, are assignable to this change" (into the lardaceous, waxy, or amyloid condition), "and must, therefore, be separated from many other similar forms as constituting a special, altogether a peculiar affection." † From the interesting account of this condition given by Dr. Harris,‡ it appears that the kidneys are generally enlarged, and that the cut surface of the cortex

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* Since writing the above, Mr. Sibley has informed me that this form of kidney is frequently found in our Dead-room in scrofulous subjects, who have died from surgical maladies, especially those in whom the bones have been much affected.

† Virchow on "Cellular Pathology," translated for the New Sydenham Society by Dr. Chance.

‡ "On the Nature of the Substance found in the Amyloid Degeneration of Various Organs of the Human Body." By Francis Harris, M.D. Cantab.

is of a pale yellowish-white colour, here and there irregularly depressed, the depressions giving the surface an uneven lobular appearance. The capsules strip off readily, leaving the surface smooth and not torn. The symptoms of this form of kidney are obscure. There is generally anasarca more or less considerable, a great proportion of albumen in the urine, and also some small pale waxy casts, and a few epithelial cells, and red blood-corpuscles. The quantity of the urine is generally increased, ranging from 50 or 60 ounces and upwards to 100 ounces or more, and its specific gravity is almost always below 1012. It being a constitutional disease, and the urine containing but a very small proportion of urea, the general symptoms are severe, especially the nervous symptoms. If, in addition to these symptoms, there be others indicative of kidney disease, and the person be scrofulous, phthisical, or has suffered from syphilis, we shall have good grounds for concluding that he is the subject of the amyloid degeneration of the kidney, more especially if there be co-existent enlargement of the liver and spleen.

The next form is the fatty kidney. In most, indeed in all, of the other forms of these affections, the kidney may undergo the fatty metamorphosis, but especially is it prone to take place in the large white kidney, and in the mixed white and granular kidney. Virchow has found that the kidney, whose epithelium has passed into a fatty degeneration, nearly always shrivels up, and the result is a permanent atrophy. But when the pure typical white kidney undergoes this metamor-

phosis there is but little diminution in size, and the exudative matter deposited in the tubules and intertubular substance seems to undergo a still further degeneration into fatty and oily matter. This condition will generally be found in persons who have been addicted to intemperance, especially in the use of undiluted spirits—as brandy, gin, and whisky.

The symptoms indicative of the fatty kidney will be more or less modified according to the conditions of the organ with which this metamorphosis is associated, and also with the greater or smaller amount of this degeneration in other organs of the body, especially in the heart and arteries. There is generally very considerable anasarca, although great fatty degeneration of the organ has been found where no anasarca was observed during life. The same may be said, also, with regard to albumen. When the white kidney is the seat of the metamorphosis, you will invariably find considerable anasarca, and more or less of albumen, and of fat or oily casts in the urine.

Having now given a short, but I fear a very imperfect, outline and general description of the several forms and modifications of the kidney in Bright's Disease, I will endeavour to explain somewhat more minutely than I have yet done, or rather in a more connected manner, the processes by which the several forms and modifications are produced. But before I enter upon this description, I wish to direct your attention to certain points connected with the anatomy of the kidney, especially the relation which exists

between the Malpighian bodies, the tubules, and the blood-vessels, and also their relative sizes.

Anatomical Arrangement.—After the division of the renal arteries in the pelvis of the kidney, and their entry into the cortical substance between the pyramids, they divide into branches, which surround each pyramid horizontally, and at right angles. (Pl. II. fig. 1 *B*, *a*.) From these ramifications, on the side looking towards the cortex, there arise with great regularity, and for the most part at right angles, smaller arteries, which, after a few more divisions, give off fine twigs, which run outwardly, in a straight course, between the cortical fasciculi or lobules, and are aptly termed *arteriæ interlobulares*. (Pl. II. fig. 1 *b*.) These twigs support the Malpighian bodies (Pl. II. fig. 1 *d*), and, with the exception of some branches to the coats of the organ, they terminate exclusively in the formation of their vascular coils. Each interlobular artery gives off, on two, three, or four sides, a great number of fine twigs, possessing the structure of arteries, which, after running a short distance, either directly, or after dividing once, penetrate the tunic of the Malpighian body, becoming the *afferent* vessels of the coil. (Pl. II. fig. 1 *c*.) Now, the capillaries and the Malpighian bodies, so formed by the convolutions in every direction, constitute the coil, and are represented to be unsupported, and to lie loose in the expanded extremity of the convoluted uriniferous tubule. They ultimately unite by as many

branches as the *afferent* vessel divided into, to form the *efferent* vessel. (Pl. II. fig. 1 *e*.) This *efferent* vessel, also arterial in form and structure, leaves the Malpighian body near the entrance of the *afferent* vessel, and nearly opposite to the opening of the uriniferous tube, and after proceeding a short distance, breaks up into a very rich plexus of capillaries (Pl. II. fig. 1 *f*), the network of which lies between and around the tubes. (Pl. II. fig. 1 *i*.) The only exception to this is in the *efferent* vessels nearest to the pyramids, the capillaries formed by which run a *long* and *straight* course towards the papillæ, where they join others which have taken a similar direction. (Pl. II. fig. 1 *h*.) Many, indeed most, of these *arteriæ rectæ* break up into capillaries without forming any Malpighian tuft. After leaving the main arterial branch, they form an open plexus of capillaries. These soon unite, and form the *venæ rectæ,* which run parallel with each other. They are well seen in Pl. II. fig. 1. Dr. Beale pointed out this arrangement of these vessels, which he terms *vasa recta,* and through his courtesy I have had an opportunity of carefully examining the preparations from which he was led to his conclusions. Virchow also has pointed out this arrangement. One set of venous radicles lies between the lobules near the surface, and presents a stellate arrangement, and receives the blood from the first set of capillaries (or cortical capillary plexus). The other venous radicles have their origin around the pyramids, and receive the straight capillaries. The convoluted tubules, in their

expanded extremity (or Malpighian capsule, as it is called), receive the capillaries into which the *afferent* arteries break up, and in the remainder of their course lie between and among the rich plexus of capillaries which the *efferent* arteries form, while the straight or purely excretory tubes lie between the *straight* capillaries formed by those *efferent* vessels that are nearest the pyramids.

The annexed table shows the respective sizes of the different blood-vessels and tubes, and Malpighian capsules. I must request your attentive study of this table, because without it I fear that you will have but an imperfect acquaintance with the manner in which the secretion of urine is effected, as also with the pathological processes which I shall endeavour to describe. The measurements I have taken from Kölliker's "Manual of Human Histology," and from Mr. Bowman's paper in the "Philosophical Transactions." The description of the anatomical arrangement is for the most part condensed from Kölliker (Sydenham Society's edition).

I need not say that all the vessels, nerves, lymphatics, and tubes are held together by connective tissue or stroma, and that this framework or matrix, as it is called, is continuous with the capsule on the one side, and with the calyces on the other. The capsule and calyces are formed chiefly of white fibrous tissue, and, according to Kölliker, some yellow elastic fibres. These, however, are not described by most other anatomists. The only vessels that are not held

TABLE of the DIAMETER of the MALPIGHIAN BODIES, and of the URINIFEROUS TUBES, and DIFFERENT BLOOD-VESSELS, reduced to FRACTIONS of an ENGLISH INCH.

	Kölliker.	Bowman.
Straight tubes at their origin in apices of cones, from about	$\frac{1}{182}$ to $\frac{1}{111}$	$\frac{1}{300}$ to $\frac{1}{200}$
,, at their terminations at base of cones	$\frac{1}{1111}$,, $\frac{1}{617}$	$\frac{1}{600}$
,, in the bundles of Ferrein (with which diameter they enter the cortical substance)	$\frac{1}{550}$,, $\frac{1}{45}$	
Convoluted tubules	$\frac{1}{333}$	$\frac{1}{450}$ to $\frac{1}{480}$
Malpighian capsule	$\frac{1}{182}$,, $\frac{1}{1111}$	$\frac{1}{104}$
Smaller arteries give off fine twigs termed Arteriæ interlobulares, in diameter	$\frac{1}{183}$,, $\frac{1}{110}$	
Each Arteria interlobularis gives off a great number of "afferent vessels"	$\frac{1}{1389}$,, $\frac{1}{555}$	
Vas afferens, convolution of, in Malpighian tuft	$\frac{1}{2750}$,, $\frac{1}{1375}$	
Finest capillaries of Malpighian tuft—diameter	$\frac{1}{3705}$,, $\frac{1}{2777}$	
Vasa efferentia in cartical substance	$\frac{1}{2777}$,, $\frac{1}{1387}$	
Capillaries into which they break up	$\frac{1}{5656}$, $\frac{1}{2777}$,, $\frac{1}{1820}$	
Rounded angular meshes between them—width	$\frac{1}{2222}$,, $\frac{1}{741}$	
Vasa efferentia in nearest contiguity with Malpighian pyramids	$\frac{1}{1100}$,, $\frac{1}{687}$	
Arteriolæ rectæ gradually attenuate to	$\frac{1}{2750}$,, $\frac{1}{1100}$	
Capillaries with which arteriolæ rectæ communicate	$\frac{1}{5500}$,, $\frac{1}{2750}$	
Membrana propria	$\frac{1}{36666}$,, $\frac{1}{27500}$	
Epithelium cells—in width	$\frac{1}{1375}$,, $\frac{1}{916}$	$\frac{1}{1000}$
Do. do. thickness	$\frac{1}{2750}$,, $\frac{1}{2200}$	
Cells of straight tubules—in width	$\frac{1}{2750}$,, $\frac{1}{1833}$	
Do. do. thickness	$\frac{1}{2750}$	
Membrana propria of Malpighian bodies	$\frac{1}{25000}$,, $\frac{1}{13750}$	
Membrane, thickness of	$\frac{1}{1100}$,, $\frac{1}{550}$	

PATHOLOGICAL ALTERATIONS of URINIFEROUS TUBES as to SIZE.

Membrana propria frequently thickened to	$\frac{1}{11000}$ to $\frac{1}{5500}$
Epithelial cells enlarged to diameter of	$\frac{1}{550}$
Or dilated into slender cysts—in length	$\frac{1}{250}$,, $\frac{1}{133}$
Or wasted into mere cords or fibres of extreme tenuity.	

together by connective tissue are the Malpighian capillaries, which hang loose in the capsule, and are only covered by an extremely delicate reflexion of the capsule.

You will perceive from this anatomical description, that if the Malpighian capillaries (being entirely within, or inclosed, in a manner, by the capsule) permit any transudation or exudation through their walls, or extravasation (by their rupture), the transuded, exuded, or extravasated matters must of necessity be in the tubules, and in no other part, unless (which probably frequently happens) the quantity of extravasated matters—in fact, the hæmorrhage—is so great, or so suddenly poured out, as to distend the capsule, or upper portion of the tube, to such an extent as to burst it, when the extravasation will find its way into the interstices of the intertubular substance. This happens in every case with artificial injection of the vessels, and we are certain it takes place from intense congestion during life by irritating substances—as turpentine, cantharides, &c.—and has often been witnessed after death. It is probable that the Malpighian capillaries almost, if not completely, fill the capsule; and it is known (as you will see in the above table of admeasurements) that the uriniferous tubules, immediately before their expansion to form the capsule, and so embrace the convoluted capillaries, become considerably narrowed. This offers some impediment to the escape of fluid; so that, if any cause of congestion be in operation, whether active from

inflammation, or passive from obstructive disease of the heart, or obstruction to the venous circulation from emphysema, or capillary congestion from a weak left ventricle, and extravasation take place, some of the extravasated matter will certainly make its escape by the tubes, but some will also run into the surrounding tissue between them, and so exert more or less pressure upon the tubules below, and will therefore lead to still greater extravasation into the intertubular tissue. But an irritant, such as turpentine, cantharides, copaiba, alcohol, even the poison of scarlatina, may not be so concentrated as to produce this violent and immediate effect upon the Malpighian capillaries, and the congestion of these will be accompanied by a simultaneous congestion, and blood-delay in the intertubular plexus. In this case, transudation or exudation, or extravasation by rupture, may not only take place from the first set of capillaries into the tubules, but from the second set also, and therefore into the tissues between the tubes, like the blood plasma normally transuded for nutrition, and also, it may be, for secretion, and finally blood stasis may be produced. The large efferent vessels near the pyramids will now probably become the only ones permitting of any circulation, sluggish and retarded though it may be. Here it is necessary always to have in remembrance the relation which the intertubular capillaries bear to the tubes, for otherwise you will be liable to fall into the error (as I believe it is) of likening some morbid states of the kidney to bronchitis. The arrangement of these

capillaries is peculiar; they are very small, and are exceedingly numerous, and do not—indeed, could not, from their respective sizes—ramify upon the walls of the tubules in any manner at all resembling that in which the beautiful network of capillaries is situated upon the mucous membrane lining even the ultimate bronchial ramifications and pouch-like depressions or cells. The capillaries and vessels near the surface of the cortex of the kidney seem to form the entire tissue of the organ, and the tubules merely lie among them, and seem to have no functional relation to them, more than that they happen to be placed there. Any effusion, of whatever nature, from the intertubular capillaries, must first be in the intertubular tissue, and cannot gain access to the interior of the tubules, except by imbibition, or osmotic action of the epithelial cells; and if that effusion be unusually great, or unusually plastic and thick, it must press upon the tubules, and more or less completely occlude their central canal or channel. It is impossible that they can be ruptured by such pressure; that can only take place by a distending force from within, as I have no doubt is often the case.

LECTURE X.

ON THE NATURE OF THE PROCESSES LEADING TO THE SEVERAL FORMS OF BRIGHT'S KIDNEY.

The Process of Formation of the Large White Kidney.—You will have perceived, from what I said when describing the effect of scarlatina, when a cause of kidney disease, that I regarded this form as inflammatory in its origin and nature.

With reference to the inflammatory process, it is impossible to say in what it essentially consists, or what constitutes the difference between mere passive congestion, and that which (for want of a better term) we call inflammation. If we are ever to be permitted to dive into what now appears to us an *Arcanum impenetrabile*, it will be by applying irritating substances to, or irritating with needles, various transparent tissues, and carefully watching the effects at different stages. This has been done over and over again so far as the behaviour of the blood in the vessels, and of the vessels themselves is concerned, but has not been followed up by a careful and minute examination, step by step, of the subsequent changes, whether as nutritive alterations, new formations, or degenerations. It seems to me very desirable, also, that we should not only do this in warm-blooded and other vertebrate animals, and even classes

somewhat below these, but that we should descend still further in the animal scale, to animals in which no nervous or separate vascular system has been as yet discovered, and even to vegetable forms. There is an essentially vegetative aspect in which to regard the inflammatory process. Many of the alterations which we observe as the results of what we call inflammation, may be observed in vegetable life, and in those animals in which not a trace of nervous structure or distinct blood-vessels can be discovered. There is no doubt that the application of anything irritating or offensive to a tissue, even when far removed apparently from nerves and vessels, produces certain morbid changes; that is to say, that the nutrition deviates under this irritation, more or less, from the normal nutrition and growth, or it becomes arrested altogether, and the tissue decays, and is finally destroyed. Either the fluids drawn to the irritated parts through the interstices of the surrounding tissues by capillarity or endosmosis, or both, are no longer chemically or molecularly fit for healthy nutrition, or, which is more probable, the tissue itself, whether cellular, molecular, or fibrous, is not in a condition to exercise the normal affinities, and therefore to assimilate the nutrient fluids with which they are bathed, and an alteration in form and properties, and of development and growth, is the result; not new formations, but alterations of pre-existing forms. Cells possessing a certain normal form become metamorphosed into an entirely new form, and a persistence of the irritation may make that altered

form a permanent one. For example, cancer blastema, molecules, and cells, probably are nothing more than an alteration of normal blastema, molecules, and cells. If the irritation be in skin, mucous, serous, or synovial membranes, it will be an alteration of the cuticular or epithelial cell—epithelial cancer; if in true glandular tissue, an alteration of the gland cells; if in a fibrous tissue, with formative cells, an alteration of that fibrous tissue and those cells. These altered blastemata, molecules, and cells, like other degraded forms, both of animal and vegetable life, acquire a mode of growth and reproduction much more rapid than that of the normal blastemata, molecules, and cells, and when once formed are a centre, a *foyer*, a focus, containing all the elements of a new but degraded growth, which, in its rank and redundant reproduction, encroaches upon and destroys all the normal tissues; and, more than this, its potential blastema may be absorbed and carried to distant parts, there to become new centres of reproduction, and to pursue the same rapid and destructive course. If it were conceivable that a cell, molecule, or fibre could be conscious of an impression, and could communicate to us the nature of that impression, we should probably discover that the application of an irritating body acts like a shock, depriving it for a time, or persistently, of its properties as a living cell, molecule, or fibre, and that, while so paralyzed, it is incapable of exercising its proper affinities, and is given up to the influence of purely physical laws, and this independently of vessels and nerves. If we could be

permitted to make an analogy between unconscious things and conscious beings, the irritant would be found to produce the same stunning and paralyzing effects upon the cell, molecule, or fibre, as a sudden blow does upon the head, paralyzing for a moment all cerebral functions, and reducing the brain to the condition of an inert mass. This is probably the kind of action which Virchow observed in cartilage cells when a needle was introduced through them, and also in the cornea in *parenchymatous keratitis*. He has given the term "nutritive irritation" to this change, of which I have endeavoured to conjecture the process. In one respect, then, it is probable—nay, almost certain—that a living tissue, or even a single anatomical element, may undergo changes and departures, more or less considerable, from the normal state, and with such changes lose their natural properties, acquire others, or even fall under the influence of purely physical laws, like any other dead or effete matter. This we must bear in mind, for it is probable that most of the degenerations and nutritive alterations which we observe in epithelial cells and sublying membranes in this and the other forms of kidney in Bright's Disease, take place by a process somewhat allied, if not exactly similar, to this.

Now, we will consider inflammation in another aspect—namely, with reference to the blood. I have used the terms *transudation* and *exudation*, and *transudates* and *exudates*. Although objections may reasonably be urged against the use of these terms on many grounds,

yet I do not see how we can discover better. They do not certainly, in their etymological sense, express the idea which we wish to convey. It will be necessary, then, to state what we mean by the terms, to give ideas, in fact, to them. I have used them, and shall continue to use them, in this sense :—*Transudation* is the term used to express a passage through the interstices of the walls of the vessels of a certain fluid ; in health, it is the *blood plasma ;* in disease, it is this also, but with varying and always increased proportions of water. A *transudate* is never spontaneously coagulable. *Exudation* is the term applied to a passage through tissues, or the interstices of the walls of a vessel, of a plasma, having characters and properties altogether different from those of health. For example, the fibrin *transuded* with the blood plasma in health is not spontaneously and immediately coagulable ; in disease, or in the state which we term inflammation, it is more or less so ; but, whether it be so from a condition acquired while in the blood-vessels, or after it has left them, from mere contact with a tissue, irritated as I have endeavoured to explain above, is not known.* There is no doubt that

* It would be an error to suppose that the plasticity of an exudate depended entirely upon the quantity of fibrin which it contains. *Plastic exudations*, according to Lehmann, are met with where there is no fibrin, and non-plastic ones which contain fibrin. But, according to the same author, the plasticity of an exudation is constantly associated with the presence of a certain amount of soluble phosphates, which occur in very small quantities, or are even wholly wanting, in the transudation.

As the phosphates and potash salts can originate only in the blood-

during inflammation of any organ the whole of the blood is altered, the fibrin undergoes more or less change; but whether this be an antecedent or a consequent, it is not easy to say. In some cases it is probably the one, in others the other. In scarlatina it is certainly the former; so it is also with cold and with alcohol, when their action is general. When, however, their application is partial or topical, it is the latter. This is of great pathological interest, especially in reference to these diseases of the kidney. It helps to explain the fact, which is so often observed in this general condition of the blood from these and other causes of these affections of the kidney, that a very slight local cause of irritation will lead to an unusually severe local inflammation; on the other hand, it equally explains why a severe local inflammation is often followed or accompanied by an inflammation of some remote organ—pericarditis, pneumonia, pleurisy, from

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cells, they cannot occur in large quantities in the *exudation*, or render the transuded *liquor sanguinis* plastic, unless there be true stasis and destruction of the blood-corpuscles, when the contents of the latter transude through the lacerated or uninjured walls of the capillaries. The formation of *transudations, poor in phosphates* and *potash salts*, is solely dependent on a *retarding* of the blood-current in the capillaries, and on other mechanical relations, and in no case depends upon a *complete stasis* or destruction of the blood corpuscles; in other words, it never depends upon true inflammation. Lehmann adds, "We do not incline to the view that the plasticity of an *exudation* is *solely* owing to the presence of phosphates, although their influence on the formation of the tissues in the case of animals has been almost demonstrated by direct observation."—(Lehmann on Exudation, "Physiological Chemistry.")

exposure to the local application of cold; inflammation of the brain or membranes from want of rest, or from anxiety of mind, or great pain. In exudation, then, the matter exuded possesses certain properties which it does not possess in health. It spontaneously and immediately or quickly coagulates; it is more potential as a blastema for the development of molecules and cells, and these molecules and cells have determinate forms, varying according to the state of the blood and the cause of the inflammation. If scarlatina be the cause, these forms will be low, degenerate, and easily destructible; the fibrin mixed with albumen—albumino-fibrinous matter,—although coagulable, does not fibrillate and afford a material susceptible of any organizing or formative processes; or if it be—as it sometimes may be in the kidney—it is into the very lowest form of matter compatible with its remaining in the system, or forming a part of the organ, in which case it will degenerate more or less rapidly into a fatty condition; or, in an eminently scrofulous constitution, into an amyloid condition, when these conditions of kidney are not the results of an independent process. This exuded matter may, in better constitutions, or when the inflammation of the kidney is due to the operation of cold or alcohol, be more plastic, and take on higher forms of organization, and become converted into connective tissue. But in the white form of kidney it never does, unless a distinct, separate, and independent process is engrafted upon the old one. The exudates in this form of kidney are unfitted in

many ways for the development, growth, and nutrition of normal cells and membranes. They are unfitted, for example, for the formation and nutrition of the basement membrane and the epithelial cells of the uriniferous tubes, and these, consequently, undergo such an alteration as I have described above, or they may be rapidly destroyed, and their *débris* be either washed out with the urine, or accumulate, and become impacted in the tube, and so render it impervious to any further passage of the urine.

You will see, then, that, according to the condition of the blood, as influenced by the constitution and the cause, so will be the nature and properties of the exudate; and, according to the condition of the surrounding tissue, and of the exudate, and the mutual action of the one upon the other, so will be the products. In the white kidney, in its typical form, scarlatina being almost essentially the cause, the blood is diseased, the fibrin is diminished and possesses little plasticity, the tissues are more or less paralyzed, the matter which is exuded into the intertubular substance may undergo liquefaction, may even assume a somewhat puriform character, and may be absorbed by the lymphatics and by them carried into the circulation, or imbibed by the walls of the tubes and discharged with the urine; while that which is exuded at once into the tubes from the *Malpighian* capillaries may be either carried off with the urine, or mixed more or less with the cast-off and degraded epithelium, and so assist in the distension and obstruction of the tubes; and this

may go on until the whole tube, together with the Malpighian tuft and capsule, forms a solid cylindrical mass. In this case the increased thickness of the cortical portion will be due to this tubular distension and enlargement. On the other hand, some of the exuded matter may, and does, remain in the intertubular tissue, which it infiltrates, and there undergoes a low form of organization, and in time is converted more or less into fatty matter, when the increased thickness will be due to both these conditions.*

There is still another element in the inflammatory process which, I think, may by itself lead to all the effects which we usually see in inflammation. It seems to me an error to suppose that nerves possess no influence beyond the place in which they are actually situated. They may induce a current or a polar force in parts more or less distant, which may, in its turn, influence the chemical affinities, and confer properties

* A mistake, as it seems to me, is often made in minute descriptions of pathological conditions of the kidney in these diseases. Those descriptions seem to imply that every morbid change not only originates, but is to be found in the Malpighian bodies and tubules. Without denying, on the contrary, fully acknowledging, the fact that they are most frequently the seat of disease, yet they are not by any means exclusively so, even in the large white kidney. The mistake has arisen from considering that every appearance found to have a linear arrangement must be due to tubules, whereas, in the manipulation necessary for preparing specimens for microscopical investigation, the intertubular tissue, as well as the tubular, must assume a more or less linear arrangement. I have preparations in my possession of all the forms of Bright's kidney, which show this unmistakeably. This intertubular alteration is found more particularly in those cases where the cause chiefly affects

which might not belong to matter not under such influence. Judging from the effects of division of nerves, we cannot help coming to the conclusion that impairment, deficiency, or entire destruction of innervation will lead to changes known as inflammatory; and in the case of the white kidney, we are sure that the causes instrumental in producing it do affect the nervous system.

Lastly,—with regard to this form of kidney, you have seen that the cortical part is increased in a manner disproportionate to that of the medullary part by the causes I have pointed out. In the cortical part the increase, as we have seen, is due to enlargement and solidification generally of the tubes, or of some part of them, and to deposit in the intertubular tissue, and the smaller vessels are consequently pressed upon, and many, if not most of them, obliterated. This is not so, however, with those of the medullary portions.

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the venous and capillary circulation—or, in other words, which exert their influence on the circulation in a backward direction. The most perfect examples are those in which the cause of the kidney disease is regurgitant disease of the heart, or from emphysema, in which case, the venous radicles, and then the *secondary* capillaries, are the first which suffer passive congestion, inflammatory engorgement, and ultimately permit exudation through their walls into the intertubular substance, and all this, in many cases, before, probably, the *efferent* vessels and the *Malpighian* capillaries have become seriously involved in the congestive and inflammatory process. Even in cases where scarlatina and cold are the causes, this obstructive influence upon the circulation is not altogether in a forward direction in the order of the circulation. These causes exert a simultaneous influence in a backward direction, and upon the venous radicles and *secondary* capillaries.

These large *arteriæ rectæ* and *venæ rectæ*, and intermediate capillaries, are freely open in the majority of the cases, and permit a free passage for the blood brought by the renal artery, as any one may discover for himself by injecting a kidney so diseased with fine injection.

On the Process leading to the Formation of the Small, Hard, Contracted Kidney.—I am quite aware that different opinions are entertained by pathologists as to the nature of the changes which take place in this small, hard, contracted form of kidney,—some regarding it as a simple degeneration, and others as the result of a low and chronic process of inflammation. I believe there is a combination of the two in most cases. I shall not, however, enter into any detailed account of these opinions, but confine myself entirely to my own views of the process, which I believe are in accordance with those of many whose opinions I value very highly; and as you will, in great measure, have before you the grounds on which I entertain these views, you will have ample opportunity of judging for yourselves whether they are borne out by the evidence.

In this form of kidney there is a great increase of the connective tissue, and not only an increase, but an alteration of the tissue. It is coarser, and is sometimes, I believe, more or less mixed with fibres of the yellow fibrous element. The normal connective tissue or matrix of the kidney is extremely delicate, and this,

I suppose, has led some histologists to deny its existence altogether. It is very easily destroyed, and it is so extremely transparent, that unless considerable care is taken in the management of the light in looking at specimens of healthy kidney tissue as transparent objects, all appearance of fibres will be lost.

The atrophy and destruction, partial or complete, of the Malpighian bodies and convoluted tubes, which produce the contracted state of the organ, is, in a great measure, owing to this increase and alteration of the fibrous element. Not altogether, however; for it is probable that, for the reasons assigned in my last Lecture, there is, at the same time, and from the same cause, a degeneration and an actual wasting of these structures, independently of the mechanical effects of this increase of fibrous tissue. It is more than probable, as I there hinted, that the delicate anatomical elements composing the walls of the uriniferous tubes, and of the capillary blood-vessels, both Malpighian and secondary, are directly injured by the irritating influence of the alcohol, and other allied compounds. This is not only the case with the anatomical elements of the kidney, but probably with those of the liver and other organs also, in which this condition is usually observed. The question, then, naturally arises, To what is this increase of the fibrous element due? Is it simple hypertrophy of the matrix from increase of normal nutrition, in consequence of the constant state of congestion and blood-delay, due to the influence of the several causes which I have named as instrumental

in the production of this form of kidney—nutritive hypertrophy it may be called? Or is it from fibrillation and organization of an exudate, the result of a low and very chronic inflammatory process? Or, lastly, is it an intermediate process, partaking of the characters of both—development by cell-formation as well as by fibrillation? The blastema for this growth of fibrous tissue we have seldom, if ever, an opportunity of seeing in the kidney; for, as I have said before, it is only after the tissue has been already formed, and the kidney has been considerably atrophied, and its secreting structures are nearly gone, that death enables us to see the real condition of the organ. But, although we do not see it in the parenchyma of organs, we do on serous surfaces; and supposing that, in consequence of the different size and arrangement of the capillary blood-vessels, and the greater intensity generally of the inflammation, the resemblance is not complete, yet it may be close enough to enable us to form a notion of the process by which a plastic fibrous exudate becomes converted into fibrous tissue. In the kidney it may not always result from a slow but continuous inflammatory process. It may be from frequent exacerbations, or from separate and frequent sub-acute attacks of inflammation, owing to the more intensified action of the different causes at different times, when the exuded fibrinous blastema may undergo those changes which we observe in similar exudates on serous surfaces. It may, at times, be partially absorbed, previously undergoing liquefaction by

the more fluid portions of the serum, or it may be developed into an organized fibrous structure, either by cell-development and growth, or, which is more frequently the case, by conversion into fibrous tissue directly by the dissilience of the fibrillated blastema.

This increase having taken place, how is it likely to affect the true secreting structures? It may do so in two ways, both mechanical in their operation: first, by pressure upon them, leading to absorption; and, secondly, by pressure upon, and obliteration partial or complete of, the blood-vessels, in this way cutting off the supply of nutritive blood-plasma. This interception of blood-plasma may probably be induced in another way—by the peculiar mode of action of the causes of this form of kidney disease, either from actual coagulation of the albumen and fibrine in the blood-vessels, or from the mechanical influence of the separated or precipitated fats in a non-saponifiable form.

But, as I said before, I do not think that the atrophy and destruction of the true gland structures are entirely due to these mechanical influences; certainly not, when the cause is alcohol. I repeat that the mere contact of an irritant, for any great length of time, with the delicate gland-tissues will lead, under certain conditions, to their degeneration and ultimate destruction, somewhat in the manner described in my last Lecture. The mere contact, more or less continuous, of an irritant, such as alcohol, in the form of brandy, gin, and such ardent spirits, will produce something resembling a shock upon the tissues, alter or annihilate their inherent properties,

impair or destroy the play of their normal chemical affinities, and consequently deprive them of their assimilating powers. They die, and ceased to be renewed, from inanition, much in the same way as they lose the same properties of development, growth, and conservation, through general impairment of all the functions of the body in old age.

Having now described the processes leading to the two typical forms, you will be able to account for the modes in which the one may be grafted upon the other so as to produce the mixed varieties, especially when I have given also a description of the two remaining independent forms—namely, the Fatty and the Amyloid. I defer this description for the moment, in order that I may have the opportunity of stating that you must not expect in practice to meet very often with these forms in their typical, unmixed state. The causation in most of the cases you will find to be complex,—cold and alcohol, scarlet fever occurring in a person whose kidneys are more or less damaged, it may be, by the action of one or more of the other causes of these diseases. Or, again, these causes, for example, cold and alcohol, and others, acting upon a kidney damaged somewhat by scarlet fever, not perhaps, to the extent of producing dropsy, or any serious disturbance in the system, but still leading to considerable and very detrimental morbid changes in the organ itself and so insiduously as not to awaken the attention of the subjects of them. The purely typical forms will only be met with at those ages when their respective causes are not likely to be

complicated in their action with that of others. Looking upon scarlatina as the cause of the typical white kidney, we should expect to find, even without experience, this form in the comparatively young. I find that out of a very large number of recorded cases, in which after death this form of kidney was found, the average age is about twenty-three; while out of even a larger number, in which the hard contracted kidney was found, it is between forty-eight and fifty years. By far the most frequent forms in practice will be the mixed varieties, one or the other of those appearances characteristic of the typical forms predominating, and these mixed forms again more or less affected by the fatty metamorphosis, and more rarely by the amyloid degeneration. It is from not separating the acute from the chronic stages, and from taking the mixed varieties as so many independent forms that so much confusion has arisen. It led Rokitansky, for example, to make his long catalogue of eight, and Rayer of six different forms, the differences between them, according to their descriptions being scarcely intelligible.

On the Fatty Kidney, when occurring as an Independent Form.—I have alluded to the fatty metamorphosis which is so common in the two forms which I have already described, especially in the large white form. The exudate in this form, if it do not contain fat from the first, rapidly becomes fatty.

With regard to the process by which this indepen-

dent form of Bright's disease is produced very little is positively known. It seems to me that the only difference between this independent form, and that which accompanies, and constitutes a part of, the other forms, consists in the fact, that as in these two forms—the large white, and the small and contracted—it is a conversion or metamorphosis of abnormal blastemata and subsequent tissue-formation into fat, so this is a conversion or metamorphosis of a blastema, degraded, not by inflammation, or any palpable form of disease, but by some other condition which interferes with the nutrition of the blood, or with the proper development and growth, and healthy changes of the various proximate principles. Instead of the materials derived from digestion being converted into perfect assimilable protein principles, that process of conversion seems to be arrested, and they remain in the forms of fatty matters, which, being the only, or at least the most abundant produce of the digestive process, ultimately replaces the normal protein-tissue. But, besides this, there is strong evidence that, under certain conditions, protein-tissues may, by some process, even in the living body, be converted into fat. There is probably another source from whence fatty matters may be obtained. The effete matters, resulting from the waste of the tissues, may not be converted into such oxidisable states as are capable of being eliminated in the form of the perfect excreta of the body, and they may be metamorphosed into fat. The quantity of food daily taken, far too great for the wants of the system, will

take away a great part of the oxygen, derived from respiration, that ought to, and would otherwise, have been exclusively appropriated to the oxidation of these effete matters; and if the supply of oxygen is still further diminished by insufficient exercise, or by confinement to an impure atmosphere, the tendency to this fatty production in the body will be proportionably increased. We should, consequently, expect to find this superabundance of fatty matters in the body, and the tendency to the replacement of protein principles by fat in elderly people, in whom the respiratory changes are deficient, who take but little exercise, and take more food than they can possibly assimilate into the higher proximate principles, and protein-tissues.* In drunkards this conversion probably is more nearly allied to a form of inflammation, and is due to a complex causation. As I have already stated, alcoholic drinks are a much more frequent cause of this fatty kidney. It is impossible that the separation of fatty principles which was observed by MM. Lallemand, Perrin, and Duroy, after the administration of alcoholic compounds, can take place in the blood without obstructing the circulation through the minute capillary blood-vessels, interfering with the transudation of blood-plasma through the interstices of their walls, and leading to a superabundant admixture of these fatty principles with the plasma itself, even if it were otherwise normal in

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* See works of Lehmann, Liebig, Chevreul, and Virchow, for facts in support of this hypothesis.

composition, which it very probably is not. How can it, indeed, remain in the normal state? This separated fat comes chiefly, if not entirely, from the red blood-corpuscles, if it be true, as Lehmann asserts, that the fats of the blood are principally deposited in them.* It is not surprising, then, that tissues, whether composed of fibres, molecules, or cells, or of all of them, should undergo changes, which ultimately end in the formation of fat. Old age, too much food, too little exercise, residence in an impure atmosphere, but above all, an intemperate use of ardent spirits,—one, or more, or all, are the true causes of the fatty form of kidney, when occurring as an independent form of Bright's disease, and also, in great part, when it is an engraftment upon the others.

On the Amyloid, Lardaceous, or Waxy Kidney, when occurring as an Independent Form.—Virchow was the first to discover the true nature of the metamorphosis which the tissues undergo in this condition of the organ. Those parts of the kidney and of other organs which have undergone this metamorphosis seem to be converted into a substance analogous in its reactions with iodine and sulphuric acid to substances of the amylaceous group. On brushing over parts affected with this metamorphosis, they assume, in a few minutes, a deep red-brown colour. This seems to be distinctive, for it

* "Physiological Chemistry." Sydenham Society's edition. Vol. i. page 267.

is very different from the colour produced by iodine on organs in any other condition, and when once seen, is represented by Dr. Harris not to be mistaken. It is not cellulose, for with this substance iodine does not produce the red-brown colour; cellulose offers greater resistance to alkalies, and is convertible into sugar, which the amyloid substance is not. For the same reason it is not actual starch. The reactions with cholesterine with the same agents (for which it might otherwise have been mistaken) are essentially different. It is therefore not allied, probably, in any way to this substance. The process by which the presence of this amyloid substance may be detected is very simple, and of easy application. "When a solution of iodine is brushed over a liver which has undergone this change, the affected parts in a few minutes assume a deep red-brown colour, very different, as before stated, from the colour produced by iodine on organs in any other condition. When to these parts, thus reddened by iodine, sulphuric acid is added, a change to a bluish-red or violet-red, or deep blue purple, or even to an indigo-black, speedily commences; in some cases this colour quickly passes into a deep reddish-brown. In the Malpighian bodies, and arteries of the kidney, the bluish coloration is most marked, and in these the dilute acid is sufficient to produce it. In the liver the stronger acid is necessary, and the colour is observed with greater difficulty. Now cholesterine, when treated with strong sulphuric acid and iodine, shows a very similar blue colour; but with

iodine alone it is unchanged in colour. It is necessary, in order that the iodine shall produce its characteristic blue colour, that it undergo some amount of oxidation by the sulphuric acid." The following are Virchow's views as to the nature of the substance, its anatomical seat, and the character of the constitutional symptoms, as quoted by Dr. Harris,* from his work on "Cellular Pathology:"—

"Almost all parts of the body are capable of undergoing this process of degeneration. The affected parts become enlarged, somewhat indurated and anæmic; the cut surface is semi-transparent, but dull; the natural colour of the parts is lost, but the colour of the neighbouring parts and vessels being seen through, gives them a yellowish or brownish tinge. The coats of the small arteries are the most frequent primary seat of this infiltration, and from them it spreads to the parenchyma of the organs; the walls of the arteries become thickened, and their calibre reduced, and hence the anæmic condition of the organs. The muscular fibres of the middle coat are the parts first affected. In the place of each muscular cell a compact homogeneous body is seen, in which, in the earlier stages, the centre of the nucleus appears as a hole; this afterwards disappears, so that a kind of spindle-shaped body remains, from which all trace of cell-structure has vanished, no distinction being left between cell-wall, contents, and nucleus. When the infiltration has

* Dr. Harris, *op. cit.*, p. 21.

reached this point, it commences to invade the parenchyma of the organs. In the liver, the cells in the immediate neighbourhood of the hepatic arteries are first affected; the liver-cells gradually become homogeneous; nucleus and cell-wall gradually disappear; and at last nothing is left but an absolutely homogeneous shining body; the cells are thus converted into a kind of corpora amylacea. In the kidney, the vessels of the Malpighian bodies and the afferent arteries first undergo this change. In the earlier stages, but little alteration is perceptible to the naked eye; the kidney appears merely indurated and anæmic, and only when a solution of iodine has been applied to it, does the change it has undergone become apparent; then, throughout the cortex numerous fine red dots appear, corresponding in their size and position to the glomeruli, and fine red streaks running from them indicate the afferent arteries.

"The disease is constitutional; one organ alone is rarely affected; the only spot where as yet an independent development of this change has been remarked, was in the permanent cartilages. The organs thus affected cease to discharge their functions; the patients assume a cachetic appearance, and gradually waste away; dropsy frequently supervenes. Sometimes, too, the whole digestive tract is affected by this degeneration. During life this is rendered manifest by continued diarrhœa, and by diminished powers of absorption."

Cysts, large or small, I am disposed to regard as

almost an inevitable, and not simply an incidental, part of the changes which constitute one or more of the forms of Bright's disease. They are of two kinds: one large, varying in size from that of a walnut, or even very much larger, down to that which is scarcely visible by the naked eye; the others almost microscopic, so that they are called by many pathologists "microscopic cysts." The large generally accompany the mixed varieties; the smaller, almost, if not invariably, accompany and form part of the small fibrous kidney. I am not speaking of, nor do I include, those cysts that are found sometimes in the kidney, but which have not their origin in Bright's disease.

It is doubtful whether these two kinds have a common mode of formation and growth. I think that it is probable that they have, the difference in size depending in great measure upon the form of disease from which they arise. I, however, wish to speak with some reserve with regard to this. They are represented (and I believe truly) to be formed in three ways: First, and most frequently, in the way first described by Dr. George Johnson, which is so palpable, as to occur to the mind of every one who is in the habit of examining attentively the kidney when so affected; secondly, in that suggested by Mr. Simon; and thirdly, by spaces in the fibrous structures, which become filled with fluid. There is no doubt that cysts are formed in other parts of the body, according to this third mode of development; but whether they are in like manner formed in the kidney, is very far from being proved, although it is certainly

probable. There are much stronger grounds for our assent to the two first modes of formation.

With reference to the first, you will remember that in all the forms of Bright's disease the tubes, from various causes, become obstructed, so that no escape of the urine can take place through them. The upper portion of the tubes becomes distended in the form of a cyst, obliterating by its pressure (if near or communicating with the capsule) the Malpighian tuft, or spreading the capillaries out, so that, in a manner, they seem to ramify upon the wall, and in this way the distended tubes become complete and perfect cysts, which are ultimately filled with a fluid not generally identical in composition with urine, but in most, if not in all, cases resembling the fluid contained in cysts in other parts of the body. Anyone who has carefully examined kidneys affected with Bright's disease, especially the mixed varieties, must have seen that the tubes often present a beaded appearance, the bead-like distensions being separated from each other by constrictions, which seem to intercept all communication between them. I am disposed to think that many cysts may in this way be formed in the same convoluted tube.

The second mode of formation is by an abnormal development and growth, or, speaking more correctly, an abnormal growth of the normal epithelial cell. Mr. Simon, in explaining this mode of formation, argues upon the assumption that the nutrition of the epithelial cells becomes altered, and that this altered nutrition

leads to an abnormal development of the germs. He thinks that the same causes which Dr. Johnson supposes to form a cyst, burst the tube, and that then what should have been intra-mural cell-growth continues, with certain modifications, as parenchytic developments. Judging from analogy with cyst formation in other parts of the body, especially in the ovary and chorion, and, moreover, from certain characters which these cysts present in the kidney, more especially their extreme minuteness, I see no reason to doubt the existence of this mode of origin of these microscopic cysts, and even sometimes of the larger ones.

LECTURE XI.

TREATMENT.

Gentlemen,—It is not an easy matter to describe, in detail, the treatment for any disease. In these diseases it is unusually difficult. I do not know, indeed, if such an attempt would be profitable; it would probably lead to confusion and mistakes. We find so many minute yet important modifications depending upon constitutional peculiarities, different habits of life, the different nature of the several causes, and the peculiar and special conditions which may surround patients labouring under one or other of these diseases, that it would be next to impossible to imagine all the states that might be present under these special circumstances, so as to be able to suggest the proper modification in the treatment. The general principles of treatment, therefore, ought to be your guides; and if you keep these clearly in view, especially in connection with the causes of the disease, the symptoms and signs, and the constitution, natural or acquired, of the individual, you ought not to have any great difficulty. As with the treatment of disease in general, so it is with the treatment of these diseases; no description, however minute, will remove the necessity of watching its effects at the bedside. How to detect and prescribe

for minute changes in the symptoms, which require sometimes one appliance and sometimes another, can only be learnt there. You will there learn how long a time is necessary, in the chronic forms more especially, before any appreciable results from the treatment can be obtained, and yet how necessary it is to persist in it from week to week, and even from month to month. Young practitioners expect an immediate result from their remedies, and are disappointed if they do not meet with it, and are therefore induced to change their mode of treatment far too often. The consequence is, that every remedy and every plan of treatment fails. In chronic diseases it requires (what one may call) an obstinate persistence in the remedies and treatment, even although we do not immediately observe any very apparent effects. The disease has become obstinate (if one may use a word expressing a voluntary perverseness with reference to an unconscious and involuntary agent), partly from organic changes, and partly from habit. The symptoms may persist merely from habit, even after the pathological conditions upon which they originally depended have been removed. This is especially the case in the chronic forms of these diseases, and a long, and even apparently fruitless, persistence in what, on general principles, is evidently the proper line of treatment to be pursued, is necessary, in order to arrive in the end at any beneficial results. In most of these diseases there are organic changes more or less permanent from the slow and insidious working of the several causes, and therefore it remains alone for us to

restore those parts of the organ that are still capable of being brought to a state fit for their proper function, imperfect though it may be. In many of the cases, all we can do will be to remove, to some small extent, the secondary effects of the disease, and to correct as far as we can the morbid action of distant organs, produced by the supplementary function imposed upon them by the imperfect secreting power of the kidneys. This part of our treatment is a very delicate and difficult one. If you stop this action, although an abnormal yet a necessary one, you will place the life of your patient in imminent peril. For example: — if you suddenly put a stop to the vomiting, or arrest the diarrhœa, the gastric and intestinal mucous membrane acting at the time as an emunctory for the urea and other excreta of the urine, your patient will almost inevitably be cut off by convulsions, apoplexy, effusion in one or more, or even in all of the great serous cavities, or in the ventricles of the brain, or in the parenchyma of the lungs. In all the chronic forms you should always endeavour to discover the organ or tissue which seems in each particular case to be acting vicariously. In the account of the symptoms, you will find it is stated that the skin is usually dry; but this is far from being always the case. Sometimes the perspirations are profuse, and in these cases the skin is, from the clearest evidence, the organ supplementary to the kidneys. This is by far the safest, indeed the only safe, emunctory for the elimination of the urinary constituents, and in all cases it will be your duty to

promote, by every means in your power, the action of the skin if it be defective, and encourage it even when considerable. In other cases it may be the gastro-intestinal mucous membrane, as I have already said; but in others it may be the serous membranes, or the subcutaneous areolar tissue, which take on this vicarious function. As in the two former cases, it will be your duty to promote, with due caution, this supplementary action; so in the two latter, you will endeavour to divert it to the skin, and partly and cautiously to the intestinal mucous membrane. You must bear in mind that these are not simple effusions, like those produced from merely mechanical causes, as from obstructive disease of the heart and lungs; they are more than these,—they are, in a manner, secretions; for, as I have already stated, urea and other constituents of the urine are found in them in large proportions. Then, again, when the effusion is in the areolar tissue, forming the general anasarca, and this be very considerable, it is recommended in books to bandage the legs by a flannel roller. Useful as this bandage is in some cases—for it is calculated to assist in the removal of the œdema, and to promote absorption by gentle pressure,—yet at other times it may produce very disastrous, or even fatal, consequences, and at all times it should be very cautiously applied, and the effects closely watched. These effusions in Bright's Disease afford great temporary relief to the more important symptoms. They are, in fact, a physical necessity, in consequence of the great distension of the vessels, and

the almost stagnant condition of the blood in them. Absorption is all but arrested under these circumstances. To apply, therefore, a roller to the lower extremities, will have for its effect only to remove the fluid to parts, the function of which is much more important, and immediately essential to life. Great caution, therefore, I repeat, should be observed in the application of this bandage in all cases of dropsy, but especially in dropsy depending upon these diseases of the kidney. As a general rule, it is never justifiable, so long as the anasarca seems to be on the increase. Under such circumstances, it is far better, and less dangerous, that vesication should take place, or that even acupuncture should be resorted to, and the serum allowed gradually to ooze away. It is singular, but nevertheless true, though not easy of explanation, that spontaneous vesications, indeed actual sloughing sores, on the lower extremities are much less liable to spread than acupunctures, or similar small punctures made with the lancet. It is not an uncommon occurrence to see patients brought into the Hospital with enormous unhealthy-looking vesications, and even sloughing sores of various sizes, from which there is a constant and copious discharge of serosity, and they generally do well; while punctures, however minute, made with the lancet, or with the grooved needle, are very often followed by rapidly-spreading erysipelas, notwithstanding that every precaution is taken to keep up the temperature of the limb, and to absorb the serosity as it flows out, by enveloping the limbs in cotton-wool and flannel.

Bearing in mind that the skin, and the mucous membranes, chiefly those of the stomach and intestines, but even of the bronchial ramifications and pulmonary air-cells, are, for the time being, acting as supplementary kidneys (one may say), it is necessary to pay great attention to the temperature, and the hygrometric condition of the atmosphere of the rooms, and also to the clothing. An exposure to a current of air even for a few moments, or to cold air so as to produce the sensation of a chill, has often been followed by rapid effusion into some internal cavity or organ, and serious disturbance, and even death, has been the result. Even breathing a sharp raw air for a short time has given rise to bronchitis, or changed the chronic bronchitic state into acute capillary bronchitis, with the same fatal result by suffocation.

As a general rule, also, when the strength will admit of it, patients generally do better when sitting up and walking about in a suitable atmosphere, while at the same time clad in flannel or other woollen clothes, than in bed. There is no doubt that muscular exercise, if regulated according to the patient's strength, is favourable to secretion and absorption. It is sometimes difficult to make patients, and still more patients' friends, sensible of this. The common remark is that the swelling goes down when the patient is in bed. They do not know that the effusion goes elsewhere, where it is much more hurtful and embarrassing. In bed these patients mostly lie on their backs, and the integuments around the loins, and covering the but-

tocks, beeome enormously œdematous, and are very liable to slough. I am disposed to think, also, that the kidneys are more embarrassed in the performanee of the small amount of funetion of whieh they are still eapable by the pressure of the œdematous lumbar integuments and museles upon them. But whatever the eause may be, there is generally more urine passed when patients are allowed to go about the ward than when they are in bed, the skin at the same time aeting quite as freely as when in bed, and they eomplain mueh less of eold. But, whether lying down or sitting up, let them be eovered with flannel, and elothed also with woollen garments; for you will reeolleet, with regard to this, what I said in my Leeture on Cold as a Cause of Disease, the layer of serum (sueh as it is) in the subeutaneous areolar tissue produces the same effeets as the applieation of a resinous varnish; it in most eases partially, if not eompletely, stops transpiration, and the temperature beeomes gradually redueed to that of the surrounding atmosphere. Œdematous limbs are almost invariably eold.

And, with referenee to this, I wish to say a few words as to baths, espeeially the moveable vapour or hot-air bath. At the onset of the disease, in the aeute forms, baths of all kinds are of great serviee. The eommon hot-water bath is indispensable in some cases, and affords very great and immediate relief. Of this I shall have to speak more at length by-and-by. But in ehronie dropsy, when the anasarea is very eonsiderable, and there is some diffieulty of breathing, they

almost invariably increase this difficulty, and produce great exhaustion and disposition to faintness. Patients frequently complain of general discomfort and distress, and, in the case of the vapour or hot-air bath, of a burning heat on the surface, whenever the temperature is raised to the degree calculated to produce the effect upon the skin which we desire.

It is also important to ascertain as early as we can how far the kidneys, or some portions of them, are still capable of secretion, by measuring not only the quantity of urine passed daily, but also the quantity of urea (by Davy's process) in the urine. By doing this, we in a manner test what the kidneys can do, and by carefully regulating the diet, and adopting other measures, we shall be able, to some extent at least, to reduce the quantity of urea and other constituents of the urine formed daily to the capacity of the diseased organs for secretion.

Early ascertain how far the disease in question is acute, how far chronic. That treatment which is beneficial and called for by the one, will be more or less injurious for the other.

And, lastly, as a general rule, carefully endeavour to discover the precise form of kidney disease with which you have to deal. Without keeping the several forms of these diseases before us, the same confusion will be apt to arise with reference to the treatment, but more lamentable in its consequences, as we have seen to exist with respect to the true nature of Bright's Disease. The large white, or those complex forms in which it

predominates, will require somewhat different management from the small hard and contracted, or those forms in which it constitutes the largest element; and so also with the fatty and the amyloid varieties.

Having made these general observations, I shall now proceed to describe the mode of treatment for the several forms, and as closely as I can, according to the following arrangement:—

First, the acute forms:—*a*, that due to scarlatina; *b*, to cold; *c*, to alcohol (an excessive and long-continued debauch); and *d*, that due to the action of other irritants, whether general or local.

Secondly, the chronic forms, according to the same arrangement.

First, then, with reference to the Acute Forms (*a*), *when a part of Scarlet Fever.*—As prevention is, by common consent, better than cure, a few words on the treatment of scarlet fever, more especially with reference to the prevention of kidney disease, will not be without their value. Besides, such a mode of treating the subject will be in strict accordance with the general plan upon which I have proceeded all along, and that is, to consider these affections of the kidney like other morbid affections of the system. I wish these Lectures to be a constant protest against specialism. You know that I commenced them at your request, without any special preparation, or more particular attention to these diseases than to others. There is nothing, in fact, specific in these diseases. They are referrible—as I have endeavoured to show—to the same causation as other

diseases, and it is only an accidental circumstance which determines the operation of the particular cause to the kidney; or, as with many of the causes, indeed, the affection of the kidney is only a part of a general disease, affecting more or less, and with greater or less intensity, according to circumstances, other organs of the body. The treatment must be guided by the same general principles. In a mild form of scarlatina but little treatment is necessary. To secure a moderate but efficient action of the bowels, and of the skin and kidneys, and protect the patient against exposure to cold, is all that is necessary. The action of the bowels is best secured by a dose of castor-oil, or the saline draught,—that of the skin and kidneys by the haustus ammoniæ acetatis. As long as the disease has every appearance of remaining mild, I do not, as a rule, use any other treatment. If, however, there is the slightest indication of its assuming a more severe or a malignant form, I immediately prescribe iron and quinine, or iron alone, and always in the form of the tincture of the sesquichloride.

In all cases of scarlatina (and the same remark is applicable to all diseases which are the result of the action of some animal poison), you should not discontinue your observation of the case until you have the strongest grounds for believing that all the poison has been eliminated from the system, and that the action to which its development and increase were due has entirely ceased. This is not always—indeed, scarcely ever—the case in that state which we describe by the

term Convalescence. In all cases, however mild, this is not accomplished for some weeks after. There are very few in the profession, who have had any great experience of this disease, who would consent to a person recently recovered from the feverish tumult, and the more obvious symptoms of the disease, returning to and mixing with other children and young persons whose blood is always in an active state of change from the rapid nutrition and waste at these periods of life. No one, however experienced he may be, would undertake to say when such a person may with safety hold communication with such susceptible persons. It may in some cases be some weeks before he can be permitted to do so without risk of imparting the disease. The poison still continues to be developed in him; something like the fermenting process is still going on, although the quantity of the poison generated is not sufficient to produce the febrile and other evident symptoms. As long as this is the case, any cause which will increase this process on the one hand, or diminish the resisting and restraining influence of the living body on the other, will lead to a return of the feverish and inflammatory condition of the system, in which the kidney is unusually prone to participate. In severe cases, or in the malignant form, the state of the patient will necessitate all these precautions, and this necessity will be apparent to persons who might not see it in the mild cases. But even in severe cases there is one way by which you may moderate the disease, and diminish the liability to kidney affection. Nothing has

been more clearly proved in medicine than that the feverish and other obvious symptoms in those diseases which are the result of an animal poison in the system, are not due directly to the actual dose which was received from without, by exposure to the emanations of an infected person. This poison is in a state of active molecular change, and seems to excite the same active condition of change in the proximate principles of the blood, developing, not like the action of a ferment, a product *unlike* itself, but one exactly of the same character and properties—in fact, identical in all respects; and the extent of this change and development evidently depends upon two conditions: one is the excessive activity or virulency of the thing introduced; the other is the resistance to it offered by the blood.* So long, therefore, as there is any poison in the system, it is important that no impediment should be interposed to prevent its exit from the body, and its dispersion and dilution afterwards, so that the patient may not inhale it again and again, and so be continually poisoned by his own emanations. This interruption it is—either

* In making this difference between the action of the scarlatinal poison and that of an ordinary ferment, I do not wish to imply that all morbific agents engender disease by producing an action like this. On the contrary, I am induced to think that many morbific emanations may act as true ferments, giving rise to products definite in their composition and properties, and to those phenomena which we observe in fevers and other diseases generally supposed to be contagious. There are strong grounds for believing that even the scarlatinal poison may at times be engendered in the body from inhaling, or being otherwise exposed to some mephitic emanations totally unlike itself.

from arresting the action of the skin by exposure to cold, or by the patient's breathing an atmosphere highly charged with impurities, but more especially with those derived from his own emanations—which gives rise to a fresh increase of the poison, a second feverish tumult, a second inflammatory condition of the internal organs and tissues, and, above all, inflammatory congestion and all the concomitant conditions of the kidney, and even anasarca.

During convalescence, with the view of getting rid of the poison altogether, and during the active stages of the disease, to favour its elimination from the body, and prevent its further development and increase in it, it is of great consequence that the atmosphere should be changed often. During convalescence, if the weather be mild, the patient should go into the open air, at the same time being warmly clad. If in winter, the air of the house or chamber should be entirely changed once or twice a day. If he be still in bed, and the fever is of a severe or malignant form, this change becomes essential for the patient's safety. Now, the atmosphere of a room cannot be freed from impurities while the walls remain standing. Don't be startled. New walls, for my purpose, can be built with lime. All animal poisons certainly, all atmospheric impurities probably, have a great attraction, an *adhesive* attraction, for surfaces. The rougher these surfaces are the greater the attraction. The following fact, among many others of a similar although less striking character, will show this:—When I was a resident at the London Fever

Hospital, a patient was brought to the Hospital suffering from erysipelas of the face and scalp, which had come on during an attack of fever. In this ward (which was in the form of an oblong parallelogram) were thirteen beds, six on one side, and seven on the other, the space that should have been occupied by the seventh bed being taken up by door-ways leading to, and partitions separating, the latrines, and sculleries, and bath-rooms. The patient was placed in the bed next but one to the end of the ward opposite to the scullery, and on the side on which there were seven beds. The patient in the end bed on the same side was attacked, then the patient in the next bed (the third from the end), and then in succession in every bed, until it had attacked the one in the last bed at the bottom of the ward. It then attacked the patient in the last bed on the opposite side, and so on in succession up to the fifth bed, and as far as the offices above mentioned. The only patient who escaped was in the bed *beyond* the offices. From this circumstance, and others like it, I determined, on my own responsibility, to have the walls lime-whited every month or so, according to the number of patients constantly in the ward. The records of the Hospital will show that previously erysipelas, pyæmia, and a peculiar form of œdematous laryngitis attacked great numbers, and were very fatal; but afterwards no case occurred up to the time of my leaving the Hospital, which was some two or three years, notwithstanding that during that time several cases of erysipelas were admitted.

Another fact, interesting with regard to the prophylactic treatment of these diseases of the kidney, is of sufficient importance to justify my occupying a few moments of your time in the relation. From want of sufficient accommodation for male convalescents, a ward was made on the ground-floor, which ran parallel to the main building above, and throughout the whole of its length, where arches existed before. The height of this ward was 9½ feet, and the floor 1½ foot below the level of the surrounding ground; but under the floor free ventilation was supposed to be secured by openings in the walls on each side, and by an area outside. The convalescents removed thither frequently became anasarcous, which was previously an extremely rare occurrence. This occurrence, and the number of relapses also, became so frequent, that no doubt was entertained that the ventilation was defective, and the further use of the ward was all but abandoned, and the convalescents replaced in the old wards. The anasarca and relapses were at once reduced to the same proportion as before the removal of the patients. Since this experience, I have been in the habit of insisting, in severe cases (and save in the Hospital it is only severe cases that I have an opportunity of seeing), that the patient, where practicable, shall change the room at least once a day, and that the walls of the room daily vacated shall be washed if painted, well brushed if papered, and lime-whited if distempered, and at the same time the windows and doors left open, and, if in

winter or damp weather, a fire constantly kept up. This daily removal entails no fatigue on the patient. He may be carried on the bed from one room to another without any exertion on his part, and the effect of the change, even in malignant forms of the disease, is often very striking. In some malignant cases, where the children are in nurseries, and a change of room is impossible, the walls, during the disease, should be daily lime-whited. It may be done by a careful workman without any noise sufficient to annoy the patient. I verily believe that by these simple precautions you may save many valuable lives, and prevent, in many cases, attacks of the most serious forms of these diseases of the kidney.

There is one other point connected with the treatment which I feel bound to refer to, because I think that it is influential as a preventive of these diseases, as well as eminently curative of the scarlet fever itself. I allude to the practice of giving tonics, such as quinine and iron, or iron alone, in tolerably large doses, proportioned to the severity or malignancy of the disease. I have been in the habit, for many years past, of prescribing these tonics in bad forms of scarlatina, securing, at the same time, a moderate but still efficient relief to the bowels once or twice daily by castor-oil, or some other mild aperient, with the most favourable results; nor (which is of more interest in connection with our subject) has any patient become affected with dropsy, so far as I have been able to ascertain—certainly not

in consulting practice.* In Hospital practice one cannot be so certain, for it is possible that some may have been attacked after they have been dismissed; but as most of the patients come from the neighbourhood of the Hospital, it is most probable that they would have returned if they had been attacked with dropsy.

But suppose, in spite of all your precautions, a patient is attacked with this acute form of diseased kidney, accompanied by inflammatory anasarca, what steps are we to take, first, to prevent a partial or complete suppression of urine, and our patient from being carried off by convulsions or other modes of death; and, secondly, to restore the organ to a perfectly healthy state, and so to avert its merging into the chronic, or large white kidney? This treatment must be modified according as the disease follows a malignant form of scarlatina, or is a sequel to a mild form of the fever. In the latter case, patients will bear and will require a far more active treatment than in the former; and, as a general rule, those of you who may settle in the country will find it necessary to treat them more actively by depletion than those whose future labours may be in London, or other large towns. I can most confidently inculcate this from a somewhat large experience in both. In the acute form, then, it may be necessary to take blood from the arm, the quantity being regulated by the urgency of the symptoms. When the

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* Since writing the above, my attention has been drawn to one case that has occurred of this.

patient is threatened with convulsions soon after the commencement of the attack, this should never be omitted. I know no exception to this, except in the case of one who is anæmic, or who has been much weakened previously by the scarlet fever. In this case we must be satisfied with abstracting blood from the loins by leeches or cupping. This local abstraction of blood is of great service. Generally speaking, patients labouring under this form of kidney disease bear bleeding well.

Next in efficacy, as in order of action, is the warm bath, great care being taken to prevent a chill after the removal from the bath. To avoid all risk of this, the patient should be well rubbed with dry and warm towels immediately that he rises out of the water, then placed in warm blankets, and put to bed. The warm bath is far more efficacious than the vapour or air bath, and the patient should remain in it until he makes complaint of a feeling of fatigue or of faintness. In country practice, and with the poorer class of persons, except in the case of children, this important remedy is not attainable. Under these circumstances, a very efficient substitute can be extemporized, if the symptoms be such as to lead the practitioner to think that this mode of equalizing the circulation, and of securing a free transpiration through the skin is called for: let the patient's bed be brought near a fire, or, if he be strong enough, let him sit on a chair, and be well supported. In either case, he should be closely enveloped in flannel; for example, a blanket, and over this two or three other

blankets are to be loosely thrown, so that a sort of chamber may be formed between them. Make a tube of about one inch or one and a half inch bore by rolling two or three newspapers, or other large sheets of paper; introduce one end into the chamber so constructed, and place the other end over the spout of a kettle half filled with water in an active state of ebullition, and a most efficient vapour-bath is thus formed. The only precaution to be observed with respect to this extemporaneous vapour-bath is, not to place the end of the tube too near the patient's person, or for too long a time in one situation, but to let the jet of steam fall in different parts.

An early administration of an efficient aperient is always called for, even if the bowels have been moved spontaneously before your visit. The only circumstance prohibiting the administration of a purgative is actual looseness of the bowels,—or, rather, actual diarrhœa. In some instances mere looseness may be co-incident with a loaded state of the bowels; if, therefore, you find the belly tumid, and not very resonant, you will do well, even in the case of there being a slight looseness, to give a dose of the compound jalap-powder; for example, from a scruple to half a drachm, or even two scruples, according to the strength of the patient; if with children, the dose must of course be smaller. It is better that you should be called upon to administer a warm stimulant for the weakness, and to support the strength, than that a free action of the bowels and of the skin should not be produced, and due depletion re-

sorted to. I could relate many cases where patients, chiefly young persons, have been seized with convulsions a few hours after being attacked with this form of kidney disease and anasarca, and have been placed out of danger in a few hours by a full abstraction of blood from the arm, followed by leeches at the loins and the warm-bath. If the compound jalap-powder be not at hand, or there be a disposition to vomiting, I see no objection, as some appear to do, to the saline aperients. If there be any nausea or vomiting, a dose of Epsom salts, with plenty of water, not only quickly produces several loose and even watery evacuations from the bowels, but also allays the disposition to sickness.

These, then, are the great and immediate remedies that will be called for in most cases. The extent to which they should be carried, or whether one alone or more need be resorted to, will depend on the urgency of the case. This must be left to your own judgment. Bear in mind, as a golden rule, in the treatment of all diseases, that it is better to err on the side of too little activity in the treatment than on that of too much.

Now, in most cases you will have to continue your treatment. You may not have had an opportunity of attacking the disease with these remedies at a sufficiently early period, or at the onset. Well, then, it is necessary to keep up the action of the bowels daily, either by the compound jalap-powder or the saline draughts. Two or three loose motions at least should be secured daily. You have seen, in my practice at

the Hospital, that in almost every case I order the haustus magnesiæ compositus of the Hospital Pharmacopœia every four, six, or eight hours, according to the effect (Magnes. carb. gr. v.; magnes. sulph. ʒj.; aquæ menth. pip. ʒxij. Misce.), with the most favourable results. You can bear witness that we have not lost a case in this acute form of the disease. Some recommend, and I have tried, the antimonial treatment,—either ten, fifteen, or twenty minims of the vinum antimonii potassio-tartratis in the haustus ammoniæ acetatis, every three, four, or six hours; or antim pot.-tart. gr. $\frac{1}{6}$ to $\frac{1}{4}$ in a pill, with ext. hyos., gr. iij. to iv. From an experience of both of these modes of treatment, I must confess I prefer the former, more especially as the patients are generally troubled with nausea, and frequently with vomiting. When this symptom is urgent, recollect that it is most probably (in the early stage of the acute affection) due to sympathy with the kidneys, and is an index, one may say, of the severity of the process going on there. In many cases it will be better, under these circumstances, to allow the stomach to remain at perfect rest, and not to administer any internal remedies. You will find, in the application of a few leeches to the loins, followed by the warm bath, and, if the bowels are confined, a laxative enema, a much more efficient means of arresting the vomiting than the internal administration of any medicines, the presence of which the irritable stomach will not tolerate, and a persistence in which is, therefore, calculated rather to keep up this em-

barrassing and exhausting symptom than to allay it. This symptom is often associated with severe headache, and tendency to convulsions, especially in children and young persons, and the same treatment will be equally appropriate for both. The constant application of a large linseed poultice, with which a few grains (a pinch or so) of mustard may be mixed, or of a large Markwick's epithem, or a piece of flannel, previously dipped in hot water and well wrung, will be of great service. If the flannel is used, it should be covered with gutta-percha, and over that by a thick layer of cotton-wool. If the haustus magnesiæ comp. after a few days produces great flatulency and intestinal distention, which it sometimes does, you may then give the haustus ammoniæ acetatis, with one, two, or three minims of the dilute hydrocyanic acid, and a drachm, or two drachms, of the infusion of digitalis. In children the dose must be regulated accordingly, or the acid and digitalis omitted. The last will be a safe diuretic at this period of the disease, and the hydrocyanic acid will tend to quiet the irritability of the stomach. With respect to diuretics in general, especially the stimulating diuretics, they are altogether contra-indicated: they are calculated in these acute forms to do a great deal of mischief. This does not apply, however, to the haustus ammoniæ acetatis: it acts as a diuretic, as I conclude from experience, and from the results of Poiseuille's experiments, by the rapidity with which it passes through vessels, not seemingly by stimulating their walls, but by some other

property which it possesses. As a general rule, elaterium and other drastic purgatives are not advisable in these acute affections. It is true that during their action they produce several loose and watery evacuations, and may afford temporary relief to the system, yet they unduly stimulate the mucous membrane, and render it, or its capillaries, unfit for the continuance of profuse secretion. The tendency which elaterium has to produce vomiting is an additional reason against its use in this stage of the disease. The Epsom, or what is better, although undeservedly but little used, the Glauber's salts, act even more efficiently in the first place, and do not leave the membrane and capillaries (so to say) exhausted.

At first, the severest antiphlogistic diet should alone be permitted. In general, but little diet is wanted. The patient ought to be restricted to gruel, arrowroot, and such articles of food, and no nitrogenous matters—such as beef-tea, animal broths, and so on—should be allowed. It is impossible, however, to decide for every case. You must exercise your own judgment, and be guided in this respect by the symptoms and state of your patient.

After the acute stage is over, and the urine has become abundant, the tube-casts, epithelial and bloody, and the blood-corpuscles have disappeared, when the skin has become cool and soft, and the pulse reduced to nearly the natural standard, and when the other feverish symptoms have subsided,—if there be still

anasarca, and there be very evident anæmia, you may prescribe the tincture of the sesquichloride of iron in doses of five, ten, or fifteen minims (according to the age and condition of your patient), three or four times daily, in a small wineglassful of water, and you may cautiously increase these doses. I seldom, however, find it necessary in these affections, and under these circumstances, to give more than fifteen minims even to an adult. This preparation (most probably by its styptic properties) will generally lead to the disappearance of the albumen, at the same time that it improves the quality of the blood, and gives tone to the system generally. The tannic and gallic acids have been useful under these circumstances.

b. When the disease is produced by cold, the same general principles of treatment are to be acted upon. The only difference is, that the patients, when affected from this cause, bear depletion better than after scarlatina, and that the warm baths should be more frequently repeated. The bath might be repeated twice, or oftener, in the day at the commencement, and on each occasion the patient might remain in the bath a considerable time. The restoration of the equilibrium of the circulation thus liable to be produced will tend, more than any other means, to relieve the inflammatory congestion of the kidney, and the increased action of the skin will remove to some extent the necessity for any great amount of function on the part of this organ. With the bath so used, if blood be taken freely from

thc loins by cupping or leeehes, or, in some rare eases, general blood-letting even be resorted to, the disease will rapidly yield.

c. When it is the rcsult of alcoholic poisoning, or any other direct irritant of the tissues of the organ, the eause acting more locally, general depletion will rarely, if ever, be eallcd for; but local depletion ought to be more freely resorted to, and the aetion of the bowels promoted by enemata, in preference to purgatives by the mouth. Those diureties whieh incrcase the proportions of water, and the Seltzer and Vichy waters, may be eautiously recommended.

This, then, is the plan of treatment which I have found most successful in the acute forms of these diseascs. In all cases you must be guidcd by the symptoms. In scarcely any will stimulation be justifiable.

LECTURE XII.

TREATMENT CONTINUED—CHRONIC FORMS.

Gentlemen,—In my last Lecture I described, as fully as my limited time would permit, the treatment—prophylactic and curative—of the acute forms of these affections. In this description I am afraid I omitted many points which I ought to have noticed. For example, I did not state so fully as I ought to have done the measures to be adopted when convulsions are imminent, or are actually present, and when coma seems approaching, or becoming more and more profound. I did allude incidentally to some of the steps necessary to be taken; but there are some local measures which ought not to be omitted. Local depletion by leeches or cupping to the temples will generally be called for, and at times even general blood-letting, in the case of convulsions alternating with coma; but in profound coma, the propriety of any abstraction of blood from the arm is doubtful. A large blister to the shaven scalp, extending over the nape, would be justifiable as a last resource,—death by coma being imminent,—although, as a general rule, blisters are to be avoided in these diseases, on account of strangury, which is so likely to follow their application. A comatose state alternating with convulsions, the face being flushed,

the eyes suffused, and the pulse hard and labouring, will always justify the abstraction of blood from the temples, the loins, and even at times from the arm, the amount of blood taken being measured by the urgency of the head symptoms and the general powers of the patient. And contemporaneous with this depletion, a brisk hydragogue cathartic with elaterium should be administered, and followed immediately by a hot bath, in which the patient should remain immersed until a decided calmative effect is produced. A repetition of the leeching to the temples may be required, the action of the bowels should be kept up by the daily administration of the hydragogue medicine, and the full action of the skin by the ammonia and antimony draught. If there be much sickness, small doses of the Epsom or Glauber's salts may be given in some carminative water, and the action of the bowels secured by copious enemata of warm water, with two or three ounces of the senna mixture. At the same time, a hot linseed-and-mustard poultice should be kept to the pit of the stomach and to the loins.

I will now endeavour to describe the treatment for the *chronic forms*. There is, however, a condition intermediate between the acute and chronic forms—a subacute state, which requires most careful management, and which it is very difficult to treat. There may be considerable anasarca, more or less pallor, much thirst, a preternaturally warm and dry skin, an irritable, but not easily compressible pulse, headache, and nausea or vomiting. Most of these subacute con-

ditions or states require a somewhat complex plan of treatment. We have to promote the action of the skin by the haustus ammoniæ, acetatis, or citratis, or other salines, to which we may add one, two, or three drachms of the infusion of digitalis, and ten or fifteen of the vinum antim. pot.-tart.; we may give once a day, even at this time, ten or fifteen minims of the tincture of the sesquichloride of iron, or from five to ten grains of the ammonio-citrate of iron every day with one of the meals. Every other day, a dose of the pulvis jalapæ co. may be given; and, at the same time, four or six ounces of blood may be taken from the loins by cupping or leeches. As the symptoms indicating an inflammatory action subside, and the urine becomes freer from blood-corpuscles and albumen, you may more frequently repeat the iron medicines, omit the cupping or leeches, and give the pulvis jalapæ co. less frequently. With respect to the salines, I often find it advisable to administer them two, three, or four times a day, intermediately with the iron medicines, even when the latter are given more frequently—two or three times daily with the meals. In this case the antimony should be withdrawn from the salines. Dr. Basham gives a very good formula, which is applicable for the decline of these subacute states, as well as for the chronic forms—Liq. ammon. acetatis ʒj. (ʒij.), acidi acetici diluti ♏xx. (♏xxx.—xl.) tinct. ferri sesquichlor. ♏x. (♏xv.), aquæ ℥j. (℥jss.) fiat haustus. The quantities within brackets are those which I sometimes prescribe, although, in most cases, those of Dr. Basham are much more suit-

able. Small doses, frequently repeated, seem to do better than larger ones given at longer intervals.

The Chronic Forms.—(*a*) *Those due to Scarlatina.*—In these cases, notwithstanding that the structure of the kidney is permanently damaged, we may, nevertheless, by appropriate treatment, medicinal and dietetic, restore, to a great extent, the function of the organ, reduce the anasarca, and very much improve the general condition of the patient.

The treatment in this chronic form will be influenced by the amount of anasarca present. If it be considerable, and there be—what there almost invariably is—more or less bronchitis, as indicated by the subcrepitant rhonchi, mixed with the snoring or buzzing and whistling sounds, you will be precluded from using some of the remedies that you could readily have recourse to when the anasarca is inconsiderable. For example, you can prescribe the dry cupping once or twice a week, or occasionally apply a few leeches, or even abstract, by cupping, three or four ounces of blood from the loins, under the latter condition; while in the former, the same remedies would be inapplicable. When the subcutaneous structures are largely infiltrated with dropsical effusion, the application of the dry cupping-glasses, instead of giving relief, seems to bruise the parts, producing considerable extravasation, and even inflammatory reaction and sloughing. The application of leeches, and the wounds of the scarificator, also produce inflammation of an erysipelatous

nature, which is most difficult to check, and which generally goes from bad to worse. Dry cupping, even when the anasarca is inconsiderable, should not be had recourse to very frequently. I have seen it do mischief. Instead of relieving the congestion of the kidneys, and increasing their functional power, it has seemed to increase the former, and diminish the latter. The patients often complain of a bruised feeling about the loins; the quantity of urine, instead of being increased, becomes diminished, and the amount of albumen and of deposits increased. Seldom or never have recourse to this appliance when there is much lumbar œdema, and not often when there is but little or none. But, as a fresh inflammatory action is liable to return in this chronic form of kidney, an occasional abstraction of blood, by leeches or cupping, to the extent of three or four ounces, is often of great service, although you may be giving chalybeates at the same time, and although there may be more or less pallor.

You are precluded from using counter-irritation in these cases. Blisters are altogether unadvisable, unless to the head and nape, in extreme cases, and even the application of the linseed poultice, with a pinch or so of mustard in it, is calculated sometimes to inflame the skin.

The chalybeate, the formula for which is given above, is a very useful medicine, and may be given three times a day for a considerable time; and you may add to it, from time to time, fifteen or twenty minims of the sp. æther. nitrici. The ammonio-

chloride or ammonio-citrate of iron, in from five to ten-grain doses, with the sulphuric or chloric ether, is a good medicine. The sulphate of zinc, and the tannic and gallic acids, are sometimes recommended; you may try either of them, if the iron medicines have been proved to be too stimulating. If there be not many blood-corpuscles and casts in the urine, which there seldom are in the purely chronic forms of these diseases, and if the quantity of albumen be considerable, you may try the sulphate of zinc, in doses of one to three grains, three times a day, either in the form of pill, with extract of hop, and with or without one grain of the nux vomica; or you may give the same dose in a draught, with ten minims of sulphuric ether or chloric ether. The latter medicine relieves considerably the flatulence and sensation of coldness in the stomach and bowels, which these patients generally complain of. If there happen to be actual blood, as indicated by the smoky appearance of the urine, or by microscopic examination, the gallic acid, in five or ten-grain doses, may be given, with a few drops of the diluted sulphuric acid, and a few drops of the tincture of hops, or other aromatic vegetable tincture, in an infusion of the same. But the great objection to gallic, and especially to tannic acid, is the tendency they have to produce constipation, the very state which it is so imperatively necessary to avoid in these complaints. The bowels should always be kept relaxed—two or three loose evacuations should be secured daily. Patients are always better and more comfortable when

they have, either spontaneously or by the aid of medicine, one, two, or even more evacuations every morning. The medicine most generally useful is the pulv. jalapæ co. of the London Pharmacopœia, or the following saline draught:— Magnes. sulph. or sodæ sulph., ʒj.—ʒij.; æther is sulph., ♏x.; acidi sulph. dil., ♏x.; ferri sulph., gr. j.—ij.; aq. menthæ vir., or any other aromatic water. This draught, taken the first thing in the morning once or twice a week, acts very efficiently, producing two or three loose and watery evacuations, and relieving the general symptoms considerably.

When the dyspeptic symptoms are troublesome, and there is considerable flatulency, the following pill sometimes gives relief:—Ferri sulph., gr. j.; nucis vomicæ, gr. ss.—j.; pil. Galb. co. gr. ij—iij., twice or thrice daily, taking intermediately the haustus amm. acetatis, with ten, fifteen, or twenty drops of the sp. æther. nit., and half a drachm of the oxymel of squills, especially if there be any co-existent bronchitis. If there be much nausea, you may add to this draught two or three minims of the diluted hydrocyanic acid of the London Pharmacopœia, or the same quantity of this acid with the haustus amm. citratis, and apply occasionally the linseed-meal-and-mustard poultice to the epigastrium.

Sometimes the patient complains of a nervous headache and a sensation of "hammering" in the head after the operation of the morning aperient draught. This is especially the case in elderly persons. I am led to explain this by the vessels being rigid and inelastic;

and therefore, on the withdrawal of a great amount of serum in a short time by the operation of the saline, the whole impulse of the left ventricle is thrown at once upon the distant small arteries. In this case a little warm gin and water, if there be no contra-indication to its use, will give relief.

If want of sleep be complained of, you must not give way to the importunities of the patient for "something composing." Opiates are generally, indeed almost invariably, unadvisable; they check the secretions, and occasion constipation. Yet in a few cases, most probably from constitutional peculiarity or idiosyncrasy, a small dose of some salt of morphia or of Dover's powder, conjoined with a grain or so of some aperient, as the pil. Rhei. co., or the watery extract of aloes, procures refreshing sleep, without (seemingly) checking secretion, or producing constipation or other bad effects. Instead of the opiate, we may prescribe the extract of henbane. Patients vary so much, or rather present such widely different symptoms, that it is almost impossible to lay down any uniform plan of treatment for all.

If there be much anasarca, exercise will be impossible. If, however, there be little, as much exercise as can be taken without inducing the sensation of fatigue should be recommended; and, in order that this may be carried into effect, a residence in a situation where the soil is sandy or chalky, and the air mild and dry, should be advised. Sometimes a voyage to the Cape, or to some other warm climate, or a tour in Italy, or a resi-

dence at Naples, or in the south of France, may be advisable, when the patient's state will admit of it; that is to say, when the anasarca has nearly, if not altogether, disappeared, and only a trace of albumen is still detectible in the urine. When the patient has progressed so far, the diet should be light and nutritious. Well-hung mutton, or young and tender beef, for dinner, with well-dressed mealy potatoes, fried or roasted, are the most suitable; but no pastry. Sound black tea, or good coffee (whichever seems to agree best), the unfermented, aërated bread, and a light-boiled egg, for breakfast. The principal meal should be in the middle of the day, not later than three o'clock, and the last meal two or three hours before bedtime; at the same time early retiring to bed, and early rising; rapid sponging with moderately cold water, and afterwards dry rubbing with a coarse but soft towel; and light, but warm, woollen clothing: these are the hygienic measures which ought to be strictly enjoined. A little claret, or dry sherry, or, if it be found to agree better, a small quantity of brandy-and-water, may be allowed, or, with the dinner, a tumblerful of bitter ale.

This treatment, with those general rules which I mentioned in my last Lecture, is that which I advise you to adopt in these cases. It must, of course, be modified in every case, according to the symptoms, and general state of your patient.

The Complications. — Diarrhœa is very liable to

attack patients suffering from the chronic forms of these diseases. Let me caution you again not to stop this suddenly. The haustus aromaticus, with half a drachm of the tincture of kino or of catechu, after every loose motion, will, in general, be all that will be necessary; and if there be much griping and nausea, the application of a linseed poultice, with two drachms or half an ounce of laudanum in it, to the abdomen, will give relief.

Patients are liable, as I have often said, not only to *effusion in the great serous cavities,* with gradually-increasing general anasarca, but to *attacks of actual inflammation,* accompanied by the *exudation of more or less coagulable lymph.* This is a difficult complication to deal with; in fact, we are almost powerless under such circumstances. Warm, stimulating poultices, and when there is not very much anasarca, the cautious application of blisters, and the haustus potassæ nitratis of the Hospital Pharmacopœia, comprise all that we can do under these complications. But when this complication arises, the case is next to hopeless, and the only course you can pursue is to surround the patient with such conditions as may prevent any increase of the local inflammation, and to administer such restoratives as are calculated to sustain the small amount of strength which he may still have. Sometimes the application of a few leeches, or the abstraction of a few ounces of blood by cupping, may be borne well, as with these inflammatory attacks there is a proportionate tolerance of more active treatment.

This is especially the case in head complications. It requires the greatest care and caution, however, in pericarditis, on account of the great danger of death by syncope; and in pleuritis, the amount of blood which you can venture to take away will make but a small, or scarcely appreciable, effect upon the inflammatory process affecting so extensive a membrane, the lung beneath being infiltrated with serosity, and the bronchial tubes filled with secretion.

The *bronchitic condition* is another serious and almost constant complication in these complaints, and is very frequently the immediate cause of death in the chronic forms of these diseases. Fortunate it is, that under these conditions we can administer the least stimulating diuretics; those, at least, which produce an increase in the watery constituent of the urine. These diuretics are, for the most part, expectorants also. The following formula you may find useful:—Liq. ammon. acetatis, ʒij.—ʒiij.; sp. ætheris nitrici ♏xx.—ʒss.; oxymellis scillæ, ʒss.; mist. camphoræ et aquæ ana, ℥v. M. Fiat haust.; this to be taken every four, six, or eight hours. To this draught we may add, if the expectoration be difficult and viscid, a few drops of antimonial wine; or if there be much spasm of the bronchial tubes, as indicated by the asthmatic breathing, a few drops of the sulphuric or the chloric ether; or if the powers are feeble, and the expectoration be puriform and somewhat difficult, a few grains of the sesquicarbonate of ammonia, in which case allowance must be made for the small quantity which will be converted into an acetate

by the oxymel of squill. The linseed-and-mustard poulticc may from time to time be applied to the front and sides of the chest; and if the patient is going about, he may constantly wcar a warm plaster, either of Burgundy-pitch or the compound cumin-plaster. Every precaution ought to be taken to prevent any increase or fresh attack of bronchitis. A great preservative is assuredly thc habit of cold sponging and dry rubbing every morning, wearing, when thc air is more than usually damp and raw, onc of the common and very portable respirators now sold within the means of thc very poor, and being clad in warm woollen clothes. Flannel next the skin should always be insistcd on. Occasionally it may be advisable, cven with the use of the above draught, to give tone to the weak heart, and improve thc character of the blood by some of thc least stimulating chalybeates. The ferrum redaetum, as sold by the French druggists (*fer réduit*), reduced by hydrogen according to Qucvennc and Homolle's proeess, is a very good prcparation; five to eight or ten grains may be given daily, mixed in jelly, bcfore, at, or a littlc after dinner, or the sulphate in doses of one or two grains.

Onc of the great ends we ought to aim at is to keep down as much as possible thc anasarca. If once it becomc considerablc, our treatmcnt will be complicated. In most of the cases that we mcet with, as in-patients of thc hospital, therc is considcrable anasarca. It is on aceount of this symptom chiefly that they seck admission; and we are called upon not only to encounter

this embarrassing symptom, but also other serious complications. It is necessary to bear this in mind with reference to the treatment. In hospital practice, a more active and a more complex treatment is required than in private practice. In private practice, except with the very poor, your treatment will in a great measure be preventive of these secondary effects and complications, by observing and carrying into effect the general principles to which I directed your attention at the beginning.

Mercurial preparations are contra-indicated in these diseases, and are highly injurious. Occasionally, a grain or two of blue-pill, or the hydr. c. cretâ, may be usefully combined with other aperients in the form of a pill; but in general, other cholagogues, such as taraxacum, the mixed acids, with a vegetable bitter twice a day, will be better, with the mild aperient pill given at night. As an occasional mild aperient, a pill made according to the following formula will answer very well:—℞ Pil. Rhei. co. gr. ij.—iij.; or, Ext. aloes aquosi, gr. j., nucis vomicæ, gr. j. pil. Galb. co. gr. ii.

Such are the general directions with regard to the treatment of the sub-acute and chronic forms after scarlatina, or for the large white kidney.

The same general principles are to be acted upon for (*b*) that produced by cold. But with reference to this, you will recollect what I have before stated, that the form of kidney produced by cold is generally a mixed form, and in some respects unlike that which is

produced by scarlatina. It generally partakes of the characters of both of the typical forms. It is generally the chronic state produced by a simple, and not, as in scarlatina, by a peculiar or special inflammatory process. We observe not only the alteration of the white forms, which are characteristic, but also the fibrous conversion of the exudate, as in the hard and contracted form. Generally speaking, in patients suffering from this form, the anasarca is not so considerable as in the other forms, unless after a recent and prolonged exposure to cold, and a fresh and active process be grafted upon the product of the former one. A great deal may be done in warding off the effects of changes in the kidney by proper hygienic management, and carefully looking to the secretions of other organs, especially those more or less complementary to the kidneys. In this, and in the next form (*c*),—that due to alcohol,—as well as in (*d*) that due to the other irritants, local and general, the diet should be in strict relation, so far as the nitrogenous articles of food are concerned, to the enfeebled powers of the kidneys, and the general directions which I have already given for promoting the action of the skin by tepid sponging and dry rubbing should be observed.

When you have reason to conclude that the fatty metamorphosis has taken place in the large white kidney, or is present as an independent form, abstraction of blood, and other active treatment, will be uncalled for, and the treatment by chalybeates should be adopted. Whatever is calculated to give tone to

the system, improve the quality of the blood, and promote nutrition, should be recommended, and persisted in.

The same plan of treatment will be necessary for the amyloid degeneration. You will find that patients affected with these forms of kidney disease seem to improve by the chalybeate treatment much more evidently than those suffering from the other forms, and bear its persistence for a much longer time.

In cases where there is a gouty condition of the system, associated with the kidney affection, you might conjoin with your medicines a few minims of the tincture or wine of colchicum, or give the compound colchicum pill of our Pharmacopœia at night (ext. colch. acetici. grs. ij. pulv. ipecac. co. grs. iij.).

Sometimes the presence of albumen in the urine is undoubtedly related to and depends upon a rheumatic condition of the system. The iodide of potassium has often disappointed me. But, in the case of a Norfolk gentleman, who occasionally consults me, and who with co-existent rheumatism passes a considerable quantity of albumen, it almost invariably produces immediate relief, and rapidly diminishes the proportion of albumen. I was at first led to imagine that his pains depended upon a syphilitic taint; but his history renders this conclusion extremely doubtful, if not certainly unfounded. The iodide of iron in the form of syrup in drachm doses more frequently gives relief, and improves the general condition of patients in whom a rheumatic tendency is found to exist.

APPENDIX.

I.

PROCESSES FOR DETERMINING THE QUANTITY OF UREA IN URINE.

Dr. Edmund W. Davy's, as condensed from the Philosophical Magazine, vol. vii. 4th series, p. 385.—This process is founded on the fact that urea is very readily decomposed by the chlorides, or rather hypochlorites of soda, potash, or lime; its constituent nitrogen is evolved in the gaseous state, and from the quantity of gas evolved, Dr. Davy estimated the amount of urea present.

After trying different means of carrying out that fact with a view of making it available for determining the quantity of urea in urine, Dr. Davy found that the following very simple process answered the purpose completely :—" I take a strong glass tube, about 12 or 14 inches long, closed at one end, and its open extremity ground smooth, and having the bore not larger than the thumb can conveniently cover. This I fill more than a third full of mercury, and afterwards pour in carefully a measured quantity of urine to be examined, which may be from a quarter to a drachm or upwards, according to the capacity of the tube; then holding the tube in one hand near its open extremity, and having the thumb in readiness to cover the aperture, I quickly fill it completely full with a solution of the hypochlorite of soda (taking care not to overflow the tube), and then instantly cover the

opening tightly with the thumb, and having rapidly inverted the tube once or twice to mix the urine with the hypochlorite, I finally open the tube under a saturated solution of common salt in water contained in a steady cup or small mortar. The mercury then flows out, and the solution of salt takes its place, and the mixture of urine and hypochlorite, being lighter than the solution of salt, will remain in the upper part of the tube, and will therefore be prevented from descending and mixing with the fluid in the cup. A rapid disengagement of minute globules of gas soon takes place in the mixture in the upper part of the tube, and the gas is then retained and collected. The tube is then left in the upright position till there is no further appearance of minute globules of gas being formed, the time being dependent on the strength of the hypochlorite, and the quantity of urea present; but the decomposition is generally completed in from three to four hours; it may, however, be left much longer, even for a day, if convenient; and having set the experiment going, it requires no further attention; and when the decomposition is completed, it is only necessary to measure the quantity of gas produced by transferring it into a graduated tube or measure." Dr. Davy has generally used a graduated tube in the first instance, as it saves the trouble of transferring the gas, and incurring the risk of losing some of it in the process. That which he recommends as being convenient for this purpose is "a stout tube, having a bore of half an inch in diameter, and capable of holding from two to three cubic inches. A tube having this bore, and about 14 inches long, will hold $2\frac{1}{2}$ cubic inches, which will be quite large enough. Each cubic inch of it should be divided into tenths and hundredths of a part of a cubic inch." *

* Graduated tubes of these dimensions and with these divisions are kept ready made by Negretti & Co., Holborn Hill.

"It is scarcely necessary to remark, that in cases where great accuracy is required, due attention must be paid to the temperature and atmospheric pressure, and certain corrections made if these should deviate from the usual standards of comparison at the time of reading off the volume of the gas; but in most cases sufficiently near approximations to accuracy may be obtained without reference to these particulars."

From a number of experiments, Dr. Davy ascertained that the quantity of gas evolved from different amounts of urea, treated in the way he describes, very closely approximates to the quantity of nitrogen gas which should be furnished from the urea by calculation.

"The fifth part of a grain of urea should furnish, by calculation, 0·3098 parts of a cubic inch of nitrogen gas at 60° Fahr. and 30° Bar.; the same quantity of urea, treated as described, furnished in one experiment 0·3001, and in another 0·3069 parts of a cubic inch of gas at the same temperature and pressure; which shows that the calculated quantity of nitrogen differs from the amount of nitrogen gas obtained by only a few thousandths of a part of a cubic inch."

"Seeing, then, that the quantity of gas evolved agrees so very closely with the calculated amount of nitrogen as being the more correct, and knowing the relation that exists between a certain quantity of urea and nitrogen, I can, from the quantity of gas evolved, in any case easily calculate the amount of urea present by the rule of three. Thus, the fifth part of a grain, or 0·2 of a grain of urea, gives, by calculation, 0·3098 parts of a cubic inch of nitrogen gas. Then 0·3098 : the volume of gas found :: 0·2 : to the required quantity of urea; or, multiplying the first and third terms by 5, we have 1·549 cubic inch of gas representing one grain of urea, which is a simpler proportion."

Using these data, Dr. Davy made several comparative

experiments on different samples of urine with his method and that of Baron Liebig, which is considered one of the most accurate of the methods of determining urea in urine at present known. The following are the results of three comparative experiments on different samples of urine, using the same with each method :—

AMOUNT OF UREA IN GRAINS, AND PARTS OF A GRAIN, IN ONE FLUID OUNCE OF URINE.

	Liebig's.	New Method.
1st experiment	3·680	3·712
2nd ,,	5·328	5·472
3rd ,,	4·976	4·976

In the first and second experiments, the quantity of common salt present in the urine was taken into account, as it is found to increase to a slight degree the apparent quantity of urea in the urine by Liebig's method. In the third, this was not taken into consideration, and the quantity of urea was compared with the mean of two results obtained by Dr. Davy's method.

Dr. Davy prefers the hypochlorite of soda to that of potash as a decomposing agent, " because the soda salt is an article of our (Dublin) Pharmacopœia, under the name of " Liquor Sodæ Chlorinatæ," and therefore can be so easily procured ; whereas the potash salt, not being used in medicine, would require to be specially made for the purpose. Dr. Davy does not think the hypochlorite of lime so effectual, and it has the disadvantage of soiling the sides of the graduated tube by the carbonate of lime formed in the reaction.

In reference to the quantity of hypochlorite of soda to be employed, it should always be used in excess ; and Dr. Davy thinks that about five or six times the volume of the urine employed would be found generally to be quite sufficient, and insure there being an excess of the hypochlorite. The amount required may be easily determined, also, by direct

experiment, by adding to a certain quantity of urine to be examined in a glass, a measured quantity of the hypochlorite, and leaving it for a short time till the evolution of gas is nearly over; then if, on the addition of more of the hypochlorite, the effervescence is renewed, it shows that there was not enough of the decomposing liquor first employed, and more must be added from time to time, till no further evolution of gas is produced; and the quantity of hypochlorite used to arrive at this point indicates the amount necessary.

Dr. Davy found, by experiment, that one grain of urea requires somewhere about half a fluid ounce of the ordinary *liquor sodæ chlorinatæ* for its complete decomposition.

The amount of mercury employed requires some little attention. It should, as a general rule, be never less than the volume of gas produced; for if the volume of gas evolved is more than that of the mercury used, it will be more than that of the solution of common salt, and therefore some of the mixture of urine and hypochlorite will be forced out of the tube before it is completely decomposed, and consequently some of the gas will be lost; so that, if this occurs, the experiment must be repeated, using either a larger quantity of mercury, if the tube will allow of it, or diminishing the quantity of urine employed.

It might be supposed, on first sight, that this method would be liable to the following source of error,—namely, that some of the gas would be evolved and lost during the pouring-in of the hypochlorite; but this is not the case, as several seconds elapse before there is any apparent reaction or evolution of gas on mixing the hypochlorite with the urine; and there is therefore full time to perform the experiment without any loss of the gas.

Dr. Davy has also ascertained that the acid reaction of the urine does not affect his method. This method is not, how-

ever, perfectly free from some slight sources of error ; the principal one being, that ammonia, if it exist in the urine, gives rise to nitrogen gas, and therefore increases the apparent amount of urea ; but the same objection holds equally against Liebig's and Ragski's methods, which are, perhaps, the two most accurate at present known.

Uric acid, also, is similarly affected by the hypochlorite ; but it and ammonia ordinarily occur in such small proportions in urine, that the error produced from these substances would be but trifling, and is partly corrected by taking the calculated quantity of nitrogen, which is something more than that obtained from a certain quantity of urea, by direct experiment.

In cases where ammonia, or uric acid, occurs in more than ordinary quantity, these substances must be separated by the usual means employed before having recourse to this method.

Dr. Davy thinks that gently heating the urine with a certain quantity of *baryta-water*, as long as the odour of ammonia is disengaged, and then filtering the solution, as recommended by Liebig, before applying his method, would effect the object very easily, and separate not only the ammonia, but also the greater part, if not all, of the uric acid present.

There is one other source of error which may arise, and which can be easily avoided. It is the following :—that if a solution of the hypochlorite of soda alone, or standing over mercury, be exposed to the light for several days, it will very gradually evolve a minute quantity of oxygen ; which shows that in determining urea we should not allow the experiments to go on for too long a time ; but if left for a day, or even two, it will scarcely make any appreciable effect on the quantity of gas evolved in testing for urea.

The reaction which appears to take place in the process seems to be the following :—The hypochlorite of soda acting

on urea gives rise to the formation of carbonic acid and water, and chloride of sodium, together with the evolution of nitrogen gas. Thus:—

Urea. 3 Hypochlorite of Soda.

$$C_2H_4N_2O_2 + 3(ClO\,NaO) = 2CO_2 + 4HO\;3Cl\,Na + N_2$$

The nitrogen is evolved, and the carbonic acid is absorbed by some of the hypochlorite of soda in excess; for Dr. Davy found that this salt absorbs carbonic acid very quickly, without evolving any other gas; and he failed in several experiments to detect the smallest portion of carbonic acid in the gas produced by acting on urea, though he always noticed the presence of a very minute quantity of oxygen in the nitrogen gas.

Dr. Davy ascertained that several of the substances found in urine during disease, as, for example, sugar, albumen, bile, and excess of urinary colouring-matter, produce scarcely any effect on the results obtained by this new method of determining the quantity of urea in the urinary secretion.

This is an excellent and very easy process for detecting the proportion of urea in the urine, and if performed with ordinary care, and pure re-agents be used, is sufficiently accurate for all practical purposes. A very useful plan for measuring the quantity of urine to be submitted to experiment, and one we find very convenient for hospital use, is that suggested by Mr. Heisch. It is to have a separate tube, with a lip to it, graduated to 50 grains and upwards. I mention 50 grains because it is a convenient quantity, and facilitates the subsequent calculations.

From the results of experiments performed by Mr. Harper with different samples of the hypochlorite of soda solutions, it is of great importance to use in Davy's process a pure specimen of the *liquor sodæ chlorinatæ*, prepared according to the pro-

cess of the Dublin pharmacopœia. If the ordinary liquor sodæ chlorinatæ of commerce be employed, very erroneous and always exaggerated results will be obtained.

Dr. Handfield Jones has suggested the following modification of the process, which I give in his own words, as transcribed from Dr. Beale's very useful work on "Urine, Urinary Deposits, and Calculi," p. 378:—"Lately I have used a bottle, of about six ounces capacity, with a curved tube of supply, and another to conduct away the gas into a graduated jar over mercury. I put into the bottle two drachms of urine or more, adjust the outleading tube to the jar, and pour in, with a pipette, a known bulk of solution of chloride of soda. This drives over, of course, a corresponding amount of air, and the gas generated, a further amount; so that in the jar I have an amount which — the volume of decomposing fluid = the gas generated. I have ascertained by trial that no alteration of volume takes place when air and nitrogen are mixed. The fluid remaining in the curved supply-tube bars all escape of gas, and it is perfectly easy to empty the bottle afterwards by simply inverting it, when the contents pour out of the gas escape-tube. By shaking the bottle frequently, I can get an experiment finished in about an hour.

"In six trials (some of them being made with a straight tube of supply going to the bottom of the jar, instead of a curved one), I obtained the following results:—

			OBSERVED. Cubic in.		CALCULATED. Cubic in.	
(*a*)	2	grains of urea gave	3·305	instead of	3·098	or ·207 +
(*b*)	2	,, ,,	3·097	,,	3·098	or ·0001 –
(*c*)	1·5	,, ,,	2·3107	,,	2·323	or ·0123 –
(*d*)	1·3	,, ,,	2·1313	,,	2·0137	or ·1276 +
(*e*)	2·5	,, ,,	3·8498	,,	3·8725	or ·0227 –
(*f*)	2	,, ,,	3·0256	,,	3·098	or ·0724 –

The figures were corrected for temperature and pressure.

In some comparative experiments on Liebig's and Davy's methods, Dr. Handfield Jones obtained the following results:

Urine, specific gravity 1024, full-coloured,—

By Liebig, gave 15·920 grains of urea per ounce.
By Davy, ,, 16·640 ,, ,, ,,

Urine, specific gravity 1007, pale, clear,—

By Liebig, ℥j. gave 5·250 grains.
By Davy, ℥j. ,, 2·636 ,,

Urine, specific gravity 1029, palish, lateritious,—

By Liebig, ℥j. gave 16·125 grains.
By Davy, ℥j. ,, 17·224 ,,

Urine, specific gravity 1018, albumen separated,—

By Liebig, ℥j. gave 10·500 grains.
By Davy, ℥j. ,, 9·760 ,,

Liebig's, Draper's, Ragski's, and Bunsen's processes are so complicated, laborious, and difficult, and are open to so many sources of error, that unless performed by experienced chemists, I should place very little value on the results obtained.

Ragski's and Bunsen's processes are based upon the same principle,—namely, upon the transformation of the urea into carbonate of ammonia. Ragski determines the ammonia in the form of ammonio-chloride of platinum. Bunsen determines the carbonic acid in the form of carbonate of baryta. Both methods give very trustworthy results, if in Ragski's method the potassio-chloride of platinum, precipitated simultaneously, be taken into account. But as I have said before, the processes are difficult and tedious.

Bunsen's process is described in the "Quarterly Journal of Chemical Science," vol. i. p. 420, and Liebig's "Annalen," March, 1848; Ragski's will be found in "Ann. der Chem. und Pharm.," 65.

Draper's method depends on the fact, that urea in solution

or in urine is immediately decomposed by nitrico-nitric acid, carbonic acid gas escaping with a brisk effervescence.—*Phil. Mag.* vol. vi. 4th series, p. 290 *et seq.*

A full description of Liebig's process will be found in the "Quarterly Journal of the Chemical Society of London," vol. vi. 1853, p. 18 *et seq.* For a good account of the analysis of the urine by the volumetric method I would refer the practitioner or student to Dr. Beale's work before mentioned.

Liebig's Test for the Presence of Urea.—"When a solution of pure urea is rendered strongly alkaline with a solution of corrosive sublimate added to it by degrees, a dazzling white precipitate is obtained, which is a combination of the peroxide of mercury with urea.

"As is well known, a dilute aqueous solution of corrosive sublimate may be mixed with an excess of a solution of bicarbonate of potash, without the immediate production of a precipitate: if a solution of urea be added to this mixture, the above-mentioned white precipitate of urea and peroxide of mercury is immediately formed. This compound is so little soluble in water, that by this process $\frac{1}{3000}$th urea can be detected with certainty in a liquid. The whole of the urea can be precipitated from urine by this means, and its application to the quantitative determination of urea, &c."—*Chem. Gaz.* vol. xii. 1854, p. 41 *et seq.*

II.

PROCESS FOR DETERMINING THE QUANTITY OF UREA IN THE SERUM OF THE BLOOD.

"A known weight of serum is first evaporated to dryness on a water-bath, at a *very gentle* heat, a precaution necessary to be observed, since a temperature of 212°, long continued, as required in this analysis, would probably cause the decom-

position of some portion of the urea. The dry residue is reduced to fine powder in a mortar, and treated with distilled water, heated to about 200°, the quantity of which may be about double the volume of the serum employed in the experiment. The mixture is allowed to digest for about half an hour at 200°, after which it may be filtered from the insoluble residue of albumen, which latter must be washed while on the filter with a little more warm water. The filtered aqueous solution is now evaporated to dryness, and the residue digested with a little absolute alcohol, at a very gentle heat, which may be continued for about half an hour, a little fresh alcohol being added occasionally, to replace that lost by evaporation. The mixture is then filtered, the clear alcoholic solution is evaporated to dryness, and the residue treated with a little lukewarm distilled water, which will then contain merely the urea, together with a small quantity of extractive matter.

"The aqueous solution thus obtained is evaporated at a very gentle heat to the consistence of a syrup, and then mixed with a few drops of pure and colourless nitric acid, the mixture being kept cool by immersing the glass containing it in a little cold water, or, still better, in a freezing mixture composed of equal weights of crystallized nitrate of ammonia and water. If urea is present, delicate crystalline plates of nitrate of urea ($C_2\ H_4\ N_2\ O_2$, HO, NO_5), will gradually appear, which, if in sufficient quantity, may be dried by gentle pressure between folds of filtering-paper, and weighed. From the weight thus obtained, that of the urea in the quantity of serum employed may be calculated as follows :—

Atomic weight of Nitrate of Urea.		Atomic weight of Urea.		Weight of Nitrate obtained.		Weight of Urea in quantity of Serum employed.
123	:	60	::	a	:	x

"If no appearance of crystallization can be detected with the naked eye, a drop of the acid liquid, cooled by means of a

freezing mixture, is to be examined under the microscope, by which means very small traces of urea may be detected."—*Mr. John E. Bowman's Handbook of Medical Chemistry*, 3rd edition.

The only modification in the above process that might with advantage be practised is that, instead of evaporating the serum supposed to contain urea, alcohol might be added to it at once. This would have the effect of holding the urea in solution, and separating a great part of the albumen. The fluid might then be filtered and treated as directed in Mr. Bowman's description.

III.

MODE OF TESTING FOR ALBUMEN IN THE URINE.

The plan of testing the urine for albumen by heat and NO^5, which is commonly practised, is, as a general rule, quite sufficient for all clinical purposes, and, if performed with moderate care, free from objections.

Boil gently in a test-tube. If albumen be present in very small quantity, a slight opalescence will be produced; if in larger quantity, the albumen will be precipitated in curdy flakes; if very abundant, the whole may gelatinize, and become nearly solid. It ought always to be observed whether the urine is acid or not. When alkaline, albumen, although present, will not be precipitated. When the urine is suspected to contain but a small quantity of albumen, it is a good plan to fill the test-tube half-full of urine, and apply heat near the surface. In this way you may contrast the opalescence produced with the layer of urine below. In order to ascertain whether the opalescence be due to albumen, it is necessary to add a few drops of strong nitric acid. It should be added in this way:—Hold the test-tube still obliquely, as during the boiling, then let the drops of nitric acid slide down the side of

the tube, when, as it falls to the bottom, it will coagulate the albumen, and thus three layers may be produced, the lowermost one being white, or opalescent, from albumen coagulated by nitric acid, the middle layer transparent, and the uppermost opalescent, or exhibiting a precipitate more or less evident of albumen coagulated by heat. As a white precipitate is produced by boiling, when the urine, free from albumen, contains an excess of earthy phosphates, it is in all cases necessary to add a few drops of nitric acid, which, in case the precipitate consists of phosphates, at once redissolves it, but if albuminous, leaves it still insoluble. If the albumen be present in very small quantity, the addition of a very slight excess of nitric acid may redissolve it, and thus lead to the supposition that the precipitate is phosphatic. A few drops more of the acid, however, will immediately cause it to reappear, if albuminous.

The test-tube should in all cases be carefully freed from any nitric acid that may have been used for a former experiment, for if a trace of nitric acid remain, no precipitate will be formed by boiling. Dr. Beale is disposed to think (and in this he has been confirmed by the results of some experiments on the subject) that this is owing to the decomposition of the phosphates by the nitric acid, and the consequent extrication of free phosphoric acid, in which albumen is freely soluble. The presence of acetic acid will also prevent the coagulation of the albumen by heat; but after it has been coagulated, a considerable quantity added will not redissolve the precipitate.

In all cases the precipitated albumen should be allowed to subside, in order that a rough approximation of the proportion of this principle in the urine may be arrived at.

To accurately determine the quantity, it will be necessary to wash the precipitate, after being certain that the whole has been coagulated, in distilled water, carefully dry it on a filter,

and weigh. In order to separate all other matters, such as lithates, &c., it will be necessary to filter the urine through fine bibulous paper before applying heat and nitric acid; repeat the filtering after this process, and carefully wash the precipitate upon the filter, the weight of which ought previously to have been accurately ascertained.

For further particulars with reference to this subject I would refer the practitioner or student to Dr. Beale "On Urine, Urinary Deposits, and Calculi;" Dr. Thudicum "On the Pathology of the Urine," and Mr. John E. Bowman's "Practical Handbook of Medical Chemistry;" "Simon's Chemistry," Sydenham Society's edition; "Lehmann's Physiological Chemistry," Cavendish Society's edition, &c.

IV.

MODE OF TESTING THE SERUM OF THE BLOOD FOR FATTY MATTERS IN CASES WHERE THE SERUM EXHIBITS ANY TURBIDITY OR MILKY APPEARANCE.

In this case it is simply sufficient to place a quantity in a strong well-stoppered bottle, add about a third of its volume of ether, shake it well, and then let it stand for some hours in a cool place. The ether will dissolve the fatty matter that may be present, and will be found floating on the surface of the serum. This is to be carefully drawn off by a pipette, and allowed to evaporate on a watch-glass, or porcelain dish, or a drop may be put on a slip of glass, and if fat has been present, it will be left after the evaporation of the ether. The ether of commerce contains more or less alcohol. This, however, is of no consequence if the serum be well shaken in the bottle after its admixture with the ether, for the latter will dissolve the fat, although the alcohol which it may contain will coagulate the albumen.

V.

MODE OF TESTING FOR THE AMYLOID DEGENERATION.

(*a.*) *According to Mulder and Harting, and followed by Virchow.*—First wash the surface of the recent section of the kidney with a weak solution of iodine (made as described below), and let diluted sulphuric acid flow over it. The iodine solution should not be too strong, for the observation may then be impeded by its precipitation; and, on the other hand, care must be taken that the iodine exerts due action upon the substance. Owing to the volatility of the iodine, and its great affinity for animal substances, its action is usually very unequal, so that the border of the object, and not the centre, may be penetrated by it; or, perhaps, of spots in close contiguity, one will contain iodine and the other not. It is, consequently, always advisable to repeat the application of the iodine several times, but to avoid the addition of too much. Upon the subsequent addition of sulphuric acid, if the action have been too powerful, the result is a perfectly opaque red-brown colour. The most certain results are obtained if the sulphuric acid be allowed to act very slowly.

(*b.*) *Method of Preparing Structures, supposed to be affected with Amyloid Degeneration, for Microscopic Examination.—Dr. Harris, in "Lancet,"* vol. ii. 1859, p. 639. —A thin section of the kidney should be made either with Beale's or Valentin's knife, carrying the section through the cortex well into the pyramids; this section is then to be spread upon a glass slide, and washed with a stream of water. After having been examined with one-inch power, a small drop of a solution of iodine, composed of twelve grains of

iodine, twenty-four grains of iodide of potassium, in one fluid ounce of distilled water, should be placed on the side of the slide, and then diluted with two large drops of ordinary water. Then allow the solution to run over the preparation, and immediately the Malpighian bodies will be seen to assume a bright carmine colour, when viewed by transmitted light, if this degeneration be present. This colour, which may have a slight orange tint, if the specimen be viewed by daylight, will be developed gradually, and will not, as a general rule, attain its maximum in less than a quarter of an hour. The solution of iodine is now to be allowed to drain off, the preparation is to be covered with thin glass, and the space between the thin glass and the slide to be filled up with ordinary water. A single small drop of the dilute sulphuric acid of the Pharmacopœia is then to be placed on the edge of the thin glass, and as it slowly diffuses itself through the water the colour instantly begins to change, becoming at first more of a port-wine colour, and then gradually passing through the various shades of the colour recently become so fashionable under the name of "red mauve," till it finally assumes an indigo-black. The parts, however, on which the acid acts less completely still retain a tinge of violet.

VI.

MODE OF TESTING FOR BILE IN URINE.

As bile may be found in the urine in some cases of these affections, I have thought it might be useful to insert a mode of detecting its presence, as well as that of sugar.

Pour a few drops of the suspected urine upon a clean white dish or plate, so as to form a thin layer of the liquid, and then carefully add a drop or two of nitric acid. When bile is present in very considerable quantity, this liquid becomes

successively pale green, violet, pink, and yellow, the colours rapidly changing as the acid mixes with the urine. If only a very small quantity of bile be present, a greenish tint may still be perceptible. To make the evidence more decisive, evaporate to some extent, and then repeat the testing.

VII.

MODE OF TESTING FOR SUGAR IN URINE.

Trommer's.—Add to about a drachm of the suspected urine two or three drops of a solution of sulphate of copper, and then a solution of potash in excess (say two drachms), a pale blue precipitate of hydrated oxide of copper will be thrown down, which, if sugar be present, will immediately be redissolved, forming a purplish-blue solution. Then heat gently up to the boiling point (but do not continue the ebullition), when, if sugar be present, a reddish or yellowish-brown precipitate of suboxide of copper will be deposited.

VIII.

MODE OF EXAMINING FOR CASTS OF TUBES, ETC.

Let all the urine passed daily be preserved in a clean vessel, and allowed to remain at rest for some hours; then carefully decant as much of the supernatant clear portion as possible without risking the loss of any of the sediment. Shake up what remains in the vessel, and put into a conical glass—an ale-glass, or old-fashioned champagne-glass, or one of the glasses suggested by Dr. Beale. Let the sediment again subside; after which, dip a tube of about the third of an inch bore, carefully ground at both ends, or slightly diminished at the lower extremity, into the fluid nearly to the bottom, the

upper end being accurately closed by the fore-finger of the right hand before its introduction into the fluid. After it has reached the bottom or the upper part of the sediment, gradually raise the finger a little, so that a small quantity may be pressed into the lower end of the tube; then close the upper end again with the finger, and withdraw the tube from the fluid. Of the small quantity retained in the lower end, let a small drop fall upon a slip of glass, and carefully cover it with a piece of thin glass, or a piece of talc, when it will be ready for examination. If much uric acid or urates be present, it will be well to take the sediment from near its surface, because these, being heavier than the casts, will occupy the lowest part. In cases where the casts, blood-corpuscles, or other matters, may be abundant, a sufficient quantity of the sediment for examination may be obtained by dipping the tube, as before directed, into the urinal. The nature of the sediment may in this case be ascertained at the bedside by one of the portable microscopes, especially by that sold by Mr. Matthews, surgical instrument maker, Portugal Street, Lincoln's-Inn Fields.

When the uric acid or urates are in great quantity, and it is desired to preserve the casts, the addition of a few drops of liquor potassæ might be added to the urine as soon as it is voided, and before the crystals have had time to form. If the potash be added in small quantity, the tube-casts may not be affected. For information as to the mode of preserving and mounting casts of uriniferous tubes, crystals, and other urinary sediments, one of the following works might be consulted:—Quckett on the Microscope, and Beale on "The Microscope in its Application to Practical Medicine," a book which ought to be in the hands of every medical practitioner.

IX.

MODE OF PUNCTURING THE LEGS IN EXTREME ANASARCA.

In a paper in the seventh volume of "Guy's Hospital Reports," part ii. p. 421, Mr. Hilton gives some directions for performing this operation, which seem worthy of trial.

With a long, narrow, sharp-pointed lancet, fixed upon a cylindrical steel shoulder, he makes the punctures along the outer side of the leg or thigh, or of both, about two or three inches apart. He thinks that four in the leg, and the same number in the thigh, will be amply sufficient, or even more than necessary, in most cases. The fewer openings made the better, provided a free escape of the dropsical fluid be obtained. Mr. Hilton has frequently found that two punctures in each part of the limb are quite enough for the intended drainage.

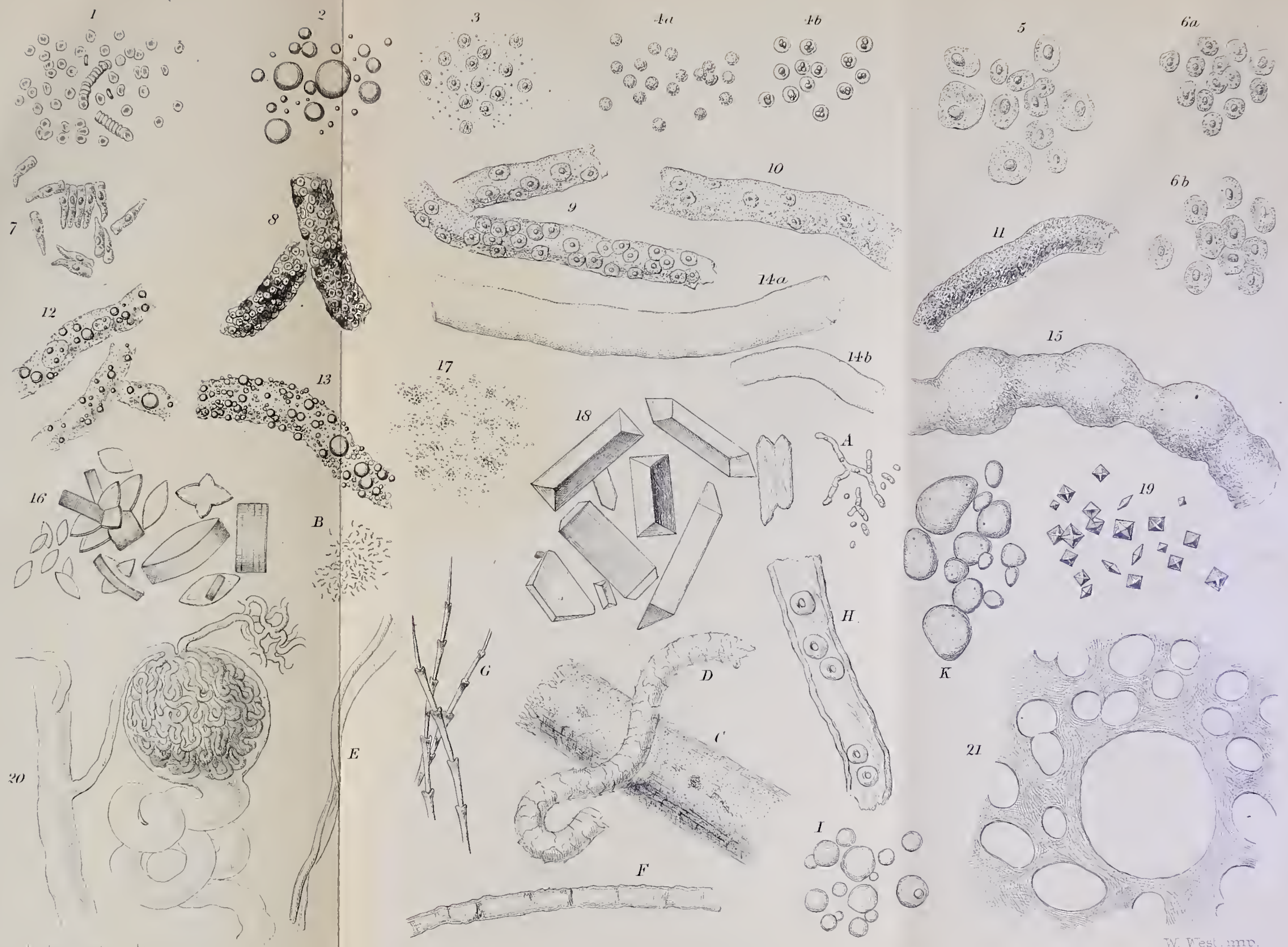
"The instrument, after perforating the skin, should be passed very obliquely, from without to within, across the limb or in a direction from below upwards [upwards and inwards ?] through the cellular tissue, between the skin and fascia covering the muscles, so as nearly to reach, but not to wound, the fascia; to intersect the meshes of the areolar tissue to the length of an inch or more; it should then be withdrawn through the same track, care being taken to disturb the parts as little as possible by external pressure with the hand. Extensive subcutaneous incisions of the cellular tissue by a lateral movement of the instrument, are, as far as I have seen, to be avoided; they are not only not required, but are liable to the objection that an injury unnecessarily extensive to a structure little capable of being repaired in a constitution already depressed by the same cause or causes which may have led to the general anasarca, would most probably be followed by the dangerous consequences usual in such cases."

Mr. Hilton prefers the outer to the inner side of the leg, "because in that part there are fewer lymphatics and veins, and because, when the patient is lying upon his back, or sitting up in bed, with the extremities everted, as usual in a state of repose, the artificial apertures for draining the body so situated occupy a lower level than could be obtained on the inner side of the limb.

"Immediately after the punctures have been made in one or both limbs, each limb should be invested with or wrapped in a separate blanket, for the purpose of keeping up or retaining the proper temperature of the limb or limbs, and to prevent any abrasion of the skin by friction of the two limbs upon each other: the blankets should be changed for others, warm and dry, before the skin of the limbs becomes chilled.

"Should the delicacy of the patient's skin, or any apprehension regarding the quality or chemical character of the effusion into the areolar tissue, suggest the probability that the skin may become excoriated or much irritated by the fluid running for a considerable length of time over it, the fluid may be made to pursue an exact course away from the limb by fixing upon the limb worsted threads (capillary conductors), so arranged that, after crossing the punctures, they shall enter gutta-percha or glass tubes, which can conduct the fluid into receptacles placed within or outside the bed."

Pl: I.



Tuffen West, sculp.

W. West imp.

All the figures x^d. 200 Diam^s, except 18, 20, 21, which are only x^d 100 Diam^s

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